

A dense, vertical collage of various objects, including a microscope, a typewriter, a starfish, a fish, a bird, a cow, and a cat, all set against a dark background. The objects are arranged in a way that they appear to be floating or overlapping, creating a complex and layered visual. The colors are muted and earthy, with a lot of brown, grey, and black tones. The overall effect is one of a chaotic yet organized collection of items, possibly representing a museum or a collection of curiosities.

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Our Cover Melange

Is strictly an editorial brainstorm, aided and abetted by our campus photographer, Mr. Gus Aschert.

Top specimen on the biological totem pole is paleontological, an early Amerind. A sardonic touch of life is added by the glass eye, and the superimposed doctoral cap. (This is believed to be the first authenticated photograph of a doctor's cap adorning an empty skull!) *Homo Americanus* is flanked on the viewer's right by an item from the embryology stockroom, and on the left by a fermentation tube filled with milk. This latter appears in deference first to the economic importance of the dairy interests, as well as to the dry states of mind in the U.S.A. Both exhibits, we are told, are very symbolic, at the human level. Overshadowing this level on the left is a dwarf bamboo, *Pleoblastus distichus* (Nakai).

The second level is dominated by an onxy-bottomed statuette of *Bison Americanus*, L. which turns its tail to an atomical model of a nerve cell, and a flask containing the Madagascar periwinkle, *Vinca rosea*, L. Some of our friends argue that the bronze bison, male, is most significant, either for its brassiness, or for other qualities, which typify the editorial policy of this magazine. (It was pure accident that the top branches of the cactus, *Opuntia brasiliensis* (Haw.) practically tickle the bull's nose.) The third level carries three specimens of marine life, — a sea fan, *Gorgonia flabellum*, L. on the left, a basket sponge, *Hyalonema longissima* (Ver.), on the right, and between them a model sea gull, species ornithologically undetermined.

Another marine form appears on the fourth level, — a jaded but definitely pickled lobster, *Homarus Americanus*, (M-Ed.). Overshadowing it and much of the next higher level, is a representative of the Australian biota, a stag-horn fern, *Platyceerium hillii*, (Moore). Next to it is an embryological model of a young tadpole, above which nod bolls of cotton, *Gossypium hirsutum*, L.

The fifth level starts out with the chlorophyll-deficient leaves of *Diefenbachia picta* (Schott), next to which is what we think is *Dermasterias imbricata* (Grube), the leather starfish of our northwestern coasts. Here, too, is a laboratory model of karyokinetic metaphase, to the reader's right of which is the Devil's apron of M.B.L. days, *Laminaria Aghardia* (Kjell.). A model mammalian heart from the anatomy laboratory is next in line. Following it to the right is an unhusked seed from *Cocos nucifera*, L., the versatile coconut. Above it flaunt the leaves of the Chinese maidenhair-tree, *Ginkgo biloba*, L. The test tube rack contains solutions demonstrating the pH of various standard fertilizers. Behind them spread the branches of another South Pacific representative, the Norfolk Island pine, *Araucaria excelsa*, R.Br. Underneath it nestles rather incongruously a model of the eight-cell

stage from an embryological series.

The sixth level in this biological "Inferno" demonstrates first the shell of the giant conch, *Strombus gigas*, L., of our southern coasts, followed by a Stender jar with histological preparations in the process of becoming. The compound microscope with a slide on its stage follows appropriately enough. (If you have missed your favorite biological subject on this page, it is no doubt the specimen on the microscope.) To your right as you look at it, is a bacteriological plate with a rather healthy colony on it, beneath which a recently hooked perch, *Perca flavescens*, L., is being hauled out on an imaginary line.

The seventh, and last, level begins with the striped strap-like leaves of the variegated screwpine, *Pandanus Veitchii*, (Dall.), beneath which are some economically significant horticultural offerings, — the onion, *Allium cepa*, L.; the banana, *Musa paradisiaca*, var. *sapientum*, (Kind.); the potato, *Solanum tuberosa*, L.; and the lemon, *Citrus Limon*, (Burm.).

To the right of these on the bottom row is a shell of the giant sea scallop, *Pecten magellanicus* (Gmelin). Continuing farther to the right we come upon a rare woodcut of the human skeleton, figured in the old Latin *Ortus Sanitatis*, the "Garden of Health," printed around 1505 A.D. This old book rests on an even older spruce log, one of those dug out of the Valdres clay at Two Creeks, Wisconsin. The Carbon-14 investigators at the University of Chicago claim that the trees of this buried forest lived some 10,500 years ago. Beneath the log at the far right is a realistic model of some *Marchantia polymorpha*, L. thalli.

Above the venerable tree trunk is a more modern conifer specimen, the 12-inch cone of our Western red fir, *Abies magnifica* (Mun.) Moving back to the left of the cone we see a herbarium mount of a horsetail, *Equisetum palustre*, L. from Switzerland. Still farther left is a bracket-fungus not uncommon in our north woods, *Fistulina hepatica* (Fr.), the beef-steak fungus. To the left of this, and bulking largest in the corner is an ancient wide-carriage typewriter which rates pride of place in our melange as representing the various forms of scientific writing, including editorial work. Perched on the letterhead is a locust, *Dissosteira carolina*, L. Facing it across the paper and coiled in and out of the machine, is a Mississippi "horn" or "hoop" snake, *Farancia abacura* (Holbrook). It slithered its way into our collection in response to the request of our past president, Dr. A. I. Ortenburger, that the noblest of the biological sciences, Herpetology, not be left out of the picture. One of our most respected contributors, Dr. David Causey, of Arkansas, takes a characteristically different view. He claims that this is definite proof of something he has suspected all along, namely that the editorial typewriter of "THE BIOLOGIST" is manned by a snake!

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Dr. Carlos I. Reed
Council Secretary from 1921-1928

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VIEWS OF ALPHEUS HYATT'S SEA-SIDE LABORATORY AND EXCERPTS FROM HIS EXPEDITIONARY CORRESPONDENCE¹

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In the summers of 1879 and 1880, Alpheus Hyatt established a marine biological laboratory in his summer home at Annisquam, Massachusetts. In 1881 this was moved to a small building on the shore of Lobster Cove near his home. For six years summer classes in marine zoology were conducted at this laboratory. Both Hyatt and his assistant, B. H. Van Vleck, served as instructors. The history of this laboratory has been traced by the writer (Dexter, 1952).

In the summer of 1955, the writer was privileged to search the attic of Hyatt's old summer home for documents which might throw further light on this laboratory, which was the prototype of the Marine Biological Laboratory at Woods Hole, Massachusetts. Two photographs were discovered depicting Hyatt's Sea-side Laboratory. Figure 1 is a view of the interior showing the students at work at their desks examining marine specimens. In the center of the room will be noted the large aquaria of salt water which were supplied with running sea-water by a windmill constructed for that purpose just outside the building. The laboratory and its windmill can be seen in the background of a photograph of Hyatt's yacht, the *Arethusa*, opposite page

232 in volume 90 of the *Essex Institute Historical Collections*. Figure 2 shows the assembled students, probably in the season of 1886, at the doorway of the laboratory. Some of them are holding marine specimens which had been collected for study.

The writer was also successful in finding some of the correspondence between Hyatt and his wife, Della, while he was away on expeditions with his yacht, the *Arethusa*. Excerpts from the log of these expeditions have already been published (Burbank and Dexter, 1954). These newly found letters present another facet in the historical account of these early expeditions to the islands of Anticosti, Labrador, and Newfoundland, planned and executed by Hyatt in pursuit of his research in the field of paleontology.

Excerpts are presented here to show the more personal aspect of Hyatt's expeditions. Hyatt's letters show his concern for his family at home, while his wife's letters keep him informed of family matters and of the situation at the Annisquam laboratory during his absence. Hyatt and his wife were very devoted to each other. Messages of endearment have not been quoted although they make up the greater part of

the correspondence. The selections used here give us an intimate picture of the pioneer naturalist and of the local gossip sent to him while he was away on his scientific expeditions.

Hyatt, with his student and expedition companion, Edward G. Gardiner, and Gilbert Davis of Annisquam who became the captain of the *Arethusa* on all of its major trips, went to Bucksport, Maine, in June, 1880, to assist with the final preparations of his new yacht. Hyatt wrote to his wife on June 17. "Gardiner, Davis, and I are at work all day long from five in the morning until dark, and six other men. There is so much to do that I think if we had not come she would not have been finished for three weeks at least. Shall, I think, get off on Saturday without fail unless the weather is bad, but will when the time comes.—The boat seems better every day."

Hyatt's wife wrote to him from Annisquam on July 19, 1880, at the time of the launching. "The *Arethusa* and her crew were the main topics yesterday. I for one realized how a ship-builder feels after launching his first ship.—A Mr. Potts of Philadelphia (Edward Potts, who became an authority on freshwater sponges and coelenterates), a friend of Prof. Cope (Edward D. Cope, formerly curator at the Philadelphia Academy of Natural Sciences and then Prof. at the University of Pennsylvania, who with Hyatt founded the Hyatt-Cope school of Neo-Lamarckianism), has written you about the sponge literature asking the name of some monograph covering a synopsis of our native species. He has reason to believe that he has found three distinct species in a single stream near him and wants to identify them (Hyatt in 1875-77 had published a *Revision of North American Porifera*).

"July 23.—Mr. Van Vleck (B. H. Van Vleck, former student of Hyatt, was in charge of the Annisquam Lab. during Hyatt's absence and was the principle instructor during the six years the lab was located at Annisquam) bought the (horse) mackerel and they have all worked at it for two days getting out its skeleton.—Your name by the way—the *Arethusa*'s rather—has already been parodied into "Are you through, Sir" in a recent letter to the Gloucester paper.—Miss Hintz (Miss Hintz, a teacher and an artist, was one of the students at the lab. and was responsible for the painting of two large frogs on the panel of the laboratory door.) has done but little from marine life yet, but I am enjoying her being here and feel a good deal of my old enthusiasm seeing her work (Mrs. Hyatt was also an artist.).—The carcass of the horse mackerel lies in the stream, being

cleaned by snails. I fancy they will make a nice specimen out of it.—Annchen (the Hyatt's daughter, who became Anna Vaughn Hyatt Huntington, the famous sculptress) asks every morning when Papa is coming home, and the other night kept turning in bed and saying, 'I am so worried, so worried about Papa. In the morning I will take the little black boat and I'll row—oh I'll row so hard 'till I reach England and find my Papa.'—I do hope you are doing some good dredging to repay you for last week.

"Aug. 3.—We were badly swindled the other night — Saturday. Mr. Van Vleck thought he saw the *Arethusa* out in the harbor and sent the young men in great haste to clean up the lab. We went to the hill to see you when he came riding down to say he was mistaken. We were none the more amiable for it.—Have you heard that the sea-serpent has been seen first in the Essex and then in the Ipswich Bay? Paper states it was seen by two reliable Newburyport captains and it was the size of a barrel around and 100 ft. long. Maybe you will meet it.—Everyone well and wants to see the *Arethusa* more than anything just now."

The following summer Hyatt made his first major expedition in the *Arethusa*. Della Hyatt wrote to her husband from Annisquam on June 19, 1881. "Friday morning when I had seen the last flutter of your flag, I went back to the house and painted desperately, so by the time the household were awake I was in a serene state of mind. I grew actually happy, I rejoiced in the wind and actually caught myself with inflated cheeks to help speed on my Bobby Shafto. But, alas! at 10 o'clock the butcher came and said 'Your folks are settin' on the sand-bar I see.' That fatal sentence took all the light out of the day. Poor Allie Alpheus Hyatt, Jr.) set out for the Light House hill and reported no sail in sight. Mr. Wilkinson says he saw you round Hali-but Point at 5 o'clock A.M. and yesterday the butcher apologized, 'It was the Tartar he saw, etc.' but the impression that you are still on the sand-bar remains. I suppose the first genuine Hawksbury post-mark I shall see will remove it.—I shall long for your first letter to know how the *Arethusa* has behaved."

Hyatt sent a telegram home after reaching the Gut of Canso. Mrs. Hyatt's reply was dated June 22. "In spite of the fact that I feel the telegram belonged partly to the 'Squam public—confess that you were a little proud of the 88 hours—it was very satisfactory. The news (the *Arethusa* reached Canso in 88 hours, later corrected to 86 hours) is all over town by this time; that I am sure of. Every one knows even just how many hams the *Arethusa* had on

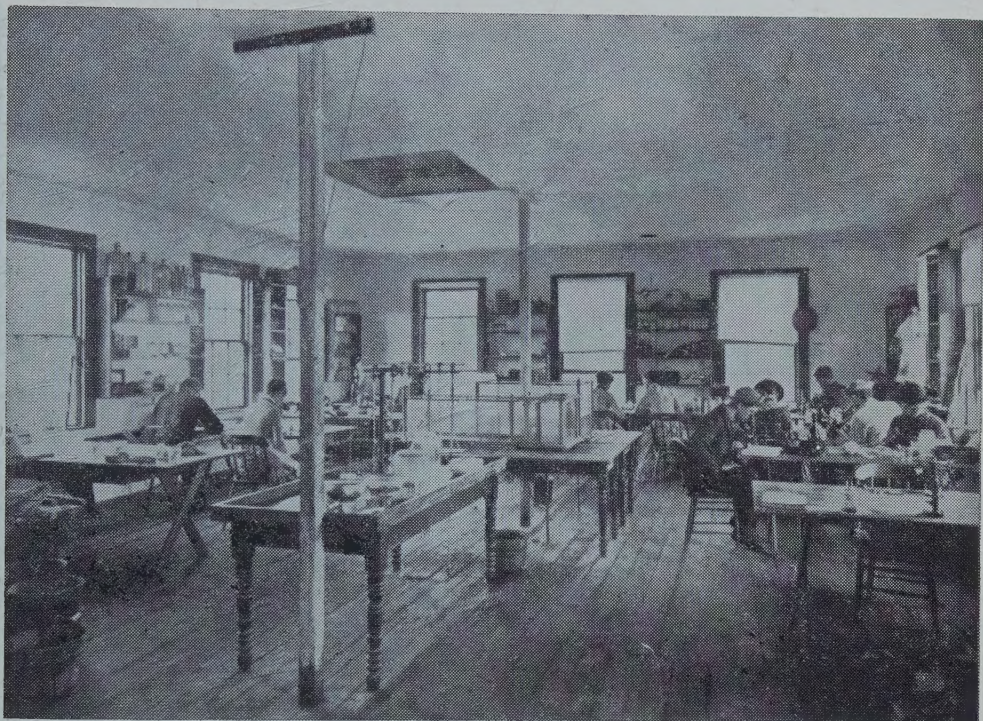


Fig. 1. The interior of Alpheus Hyatt's Sea-side Laboratory equipped with salt water aquaria supplied by a windmill adjacent to the building.

board, and every one I hear from by letter mentions having seen her departure in the papers. The children rushed off to tell Dr. Davis in triumph because he had expressed the opinion that 'he thought you weren't anywhere near the Gulf yet'.

"Mr. Van Vleck was down last evening much annoyed that Miss Martin could not come. By another mistake her room at Davis's (where the students took room and board) had been relet and every where else it was too dear for her. Miss Putnam and her friend Miss Talbot (laboratory students) called one evening this week. I hope the other young women will use as little ceremony.—I felt quite 'sat upon' last night. The cook's brother was down with clams and said he had known a fisherman to make Canso Strait in 53 hours.—The children so far have given me no trouble—and Hattie (the Hyatt's older daughter Harriett who later became the wife of Alfred G. Mayor, the famous marine zoologist who was director of the Department of Marine Biology, Carnegie Institution of Washington.) is of great service.

"June 26. Mr. Van Vleck was over last evening and evidently feels very insecurely about Mrs. Davis. He says a year or two ago she had a house full of boarders and suddenly grew tired of keeping them and they all had to find places elsewhere and there are signs of her growing wary now. He—Van Vleck—says he believes another year they will be forced into renting a house and having a housekeeper—though he also believes Miss Lane commences to see the folly of raising her prices. (Unsatisfactory arrangements for room and board accommodations prevented the lab. from attracting more students and was one of the factors for giving up the Annisquam location later.)—The children are all up in the attic today having a good time swinging and improvising. The most prominent refrain is that:

Mr. Brewster
Met a rooster
On his way
To Anticooster.

(William Brewster, ornithologist, in charge of birds and mammals at the Boston Society

of Natural History and later held the same position at the Museum of Comparative Zoology, was a member of the expedition to Anticosti at this time.) Last night we saw plainly the new comet from the attic windows. It is causing a good deal of excitement in all the observatories—they think it an old acquaintance of 1812."

Hyatt wrote to his wife from Port Hawkesbury, Cape Breton, Canada, on June 27, 1881. "We arrived here this morning. It is a little place in the Gut of Canso.—We had a very favorable passage arriving off Canso Light at the entrance of the Gut yesterday evening after being out 88 hours from Cape Ann and running on all our courses by the log 543 miles. We had considerable fog but plenty of room and encountered only one night of bad weather.—Our course is to the Magdalen Islands, then to Anticosti or Gaspé according to the weather.—The head of *Arethusa* (painted by Mrs. Hyatt to be carried in the cabin) remains bright as father's love, but the flower (flower of *Arethusa* also painted by Mrs. Hyatt) is sadly wilted by the weather."

Later he wrote from Grand Entry Harbor, Magdalen Islands, Gulf of St. Lawrence, June 29, 1881. "We arrived here yesterday after a very successful time at Entry Island. The weather has been bad at times, but we have managed to be in port or on our way to one. Shall run for Bird Rocks and Anticosti when the weather is settled and we are sure of a spell of fine weather.—At Entry Island the weather was superb and I got several photographs. How good these will be is more or less doubtful. My apparatus is more imperfect than I had suspected and gives me a good deal of trouble. Entry Island has changed very much and is wasting away with great rapidity, but the red cliffs and caverns and the sea were perfect the day we were there. I saw just the same brilliant effects as on my former visit. (His expedition here in 1861 has been reported by Dexter, 1954.) The Magdalen Islands are mountains of red sandstone 300 to 400 feet high connected by low sand bars. These are rapidly wasting away in some places and accumulating in others.—Tell Annie there are no dogs worth having here, only some curious ugly mongrels trained to go into the water after birds."

Della wrote from Annisquam, June 30. "Night before last (we had) a terrific wind shower. It awakened me just before midnight from a profound sleep by its furious blows. The lightning seemed distant but almost incessant and the sky so black save in the north; it seemed rent apart and thru the rent the comet looked simply hellish.—Its train seemed made of sparks. I went

back to bed miserably depressed and imagined all sorts of uncanny things about the *Arethusa*.—You had a letter from Dall (W. H. Dall of the Smithsonian Institution) and another from a Western college man—which fortunately I could give answers to.—Today I am going to attack the Lab. I find it's impossible to hire a work-woman.

"July 3. Of course you are ignorant now, but will know it before you read this that Garfield has had two shots from an assassin. Even here the excitement was a good deal yesterday and every one seemed relieved when last night word came that there was hope of his living.—I called on your Summer School young women yesterday. I was told that they had all arrived, but found only three. I should like to know why Mrs. Smith appealed to my motherly care of them. The youngest must have been 28 and the oldest Mrs. Morgan and I estimated at 35. There is a Dr. McClosky of Princeton and a Carl Shemper—son of a German who had a controversy with Agassiz in his glacial theory—at the school. The latter had been to Johns Hopkins—did not like it and came here with letters to you—will remain till autumn and is a botanist. Your bird permit in the Provinces has just arrived. I forwarded it with this, hoping it may yet do you some service.

"July 7. The Laboratory young women—who by the way are very uninteresting—have called, and nearly every week more women apply. I think Van Vleck is getting tired of so many 'raw recruits'—such very elementary students. He is at the end of his resources now—says there is really no more room."

Hyatt wrote home on July 13. "Since I last wrote we have visited the Magdalen Islands, Bird Rocks near them and had a run for Anticosti. We got caught in one northeaster, but it was only a summer storm and simply made us very uncomfortable for one night. Brewster has found several new and interesting things and so has Henshaw (Samuel Henshaw, ornithologist, who became curator of the Museum of Comparative Zoology), with regard to the distribution of birds. Anticosti has been our best field and has turned out more interesting than even I expected. A few days since I obtained the finest specimens of *Beatricea* than I had ever before seen and shall be able to settle the long disputed question of its affinities. (For discussion of this problem see Dexter, 1954, p. 48.) I had but the faintest hope of doing this when we started on this trip. The photos I think will turn out well, though it was a great mistake to try a new thing on a trip like this. The method will work, but it ought to be perfected at home with plenty of time.—

We are as I write rolling about on the sea



Fig. 2. The group of students attending Hyatt's Sea-side Laboratory in the session of 1886 (?) holding some of the specimens gathered for study.

somewhere off Gaspé but cannot see the land which is hidden by a dense cloud of smoke, which must come from some very large fires to the northward, we have not yet learned whence."

Mrs. Hyatt wrote on July 14, "Four weeks tomorrow since you sailed and no letter since the first one—do you wonder what I commence to feel as if I were writing to some stranger? A nice friendly letter from Mr. Scudder (Samuel H. Scudder, another former student of Agassiz and school-mate of Hyatt, who was at this time president of the Boston Society of Natural History.) yesterday enclosing check for salary—and offering to be of service in any way. Allie asks every morning just how long I think the *Arethusa* will be away and makes a great reckoning on the fact that Mr. Brewster must be back the 1st—thinks you will come too.

"July 17. Your letter made me light-hearted all day—that you had got all my letters I knew would give you contentment for the rest of your trip. I am rejoiced about your finding more of the *Beatricea*.—We had come in from a long tiresome

trip thro' the woods yesterday, and your letter was the best reward I could have had.—In a letter from Mr. Scudder yesterday he says, 'tell the Prof. that the Society has a legacy from the estate of James Davis of \$5,000—it will cheer him a little—though it ought to have been \$50,000.'—Mr. Marsh sailed up here last night in his new boat and the children asked him its name—he said the "*Henrietta*"—so, 'Squam-like, they immediately found a nickname in 'Henry-ate-her'. Ma hopes Mr. Henshaw will remember her mosses (sea-mosses or seaweeds which he promised to collect for her).

"July 23. Mr. Van Vleck has just been in for 'advice', but I fancy to ease his mind and justify himself in refusing a request made at the lab. today. It seems that there are three ministers as students, besides all the young ladies are religiously inclined and they asked to hold religious exercises in the Lab. tomorrow. As Van Vleck says the request will be repeated, Lane's boarders will join, outsiders will come in from curiosity—and if his own convictions were not at all opposed to it—it would be a nuisance

anyway. It seemed to him that he ought to say 'no' at the start on the grounds that the Lab. was there for purely scientific purposes and he had no authority in your absence to have it used for anything else. I told him that I thought he was right. These people are not debarred religious service—Bay View is in walking distance for any of them if they are too sectarian to go to the Universalist at the head of Lobster Cove. It's about as uninteresting a room full of people as I ever saw together and Van Vleck says there are not three of them who would enter the Lab. on a Sunday. One young woman would not go there to change the water on her hydroids even though she was willing that Van Vleck should do it for her." As a final solution, "the services of the Lab. people were held over the Post Office, Dr. McClosky preaching." (From letter of Mrs. Hyatt, July 28, 1881.)

Hyatt wrote to his wife on July 25. "We are on our way home at last—Shall probably have to make close along the coast of Nova Scotia and make harbors in heavy head winds and lie to for the night. Gilbert (Capt. Davis) thinks we better do this and then cut across Bay of Fundy to the Maine shore. This lengthens our trip very much but it is the wisest and safest plan and though I could brave anything to get home quickly I shall take no extra risks. I find Gilbert's judgment very excellent and not over-cautious nor yet too venturesome. His knowledge and experience are greater in some respects than I had suspected and his keenness has often been our best safeguard.—We shall land Mr. Brewster on this coast and he will take the cars for Boston.

"July 31. Our voyage home will be a long and cautious affair. We shall stick to the coast and harbor whenever the wind comes off very strong ahead.—The *Arethusa* has done the right thing so far and I shall hope for even better behavior in the next two weeks.—If anyone asks you how fast the *Arethusa* can go you can tell them that she has run 35 miles on one course in 3½ hours.—She must have made at least 11 knots for part of the time. She has several times made 10 knots an hour with only a good wind in the most favorable quarter, and you must add that she is a small boat only 17 tons and 48 feet long. So you need not be beaten by any bragging fisherman either, since the larger vessels can very rarely make 10 or 11 knots even in gales of wind."

His final letter on the 1881 expedition was written at Ship Harbor (Port Hawkesbury) on Aug. 7. "We have been in this place for four days detained by fog and head winds. Instead of being nearly to Cape Ann as I had hoped we are lying in

this quiet harbor listening to the squalls of wind sweeping through the rigging and watching with despairing eyes the eternal darkness of the lead-colored fog. — Tell Grandma we have tried to collect some seaweeds and a few have been saved, but the constant rain and mildew destroyed them almost as fast as they were collected."

On the 1885 expedition to Newfoundland Gardiner went ahead in charge of the *Arethusa*. Hyatt followed later by train to Halifax and then by steamer to St. Johns to join his vessel and crew in Newfoundland. His wife and children went to New Hampshire for the summer. Hyatt had much confusion getting to St. Johns because of poor connections between the train and steamer. He wrote from Halifax, Nova Scotia, on May 11, 1885. "The seat in the smoking car, which I selected at starting, resembled the 'Squam sofa—aesthetic but not comfortable.—I find my cap is a great attraction. The conductor insisted on being very polite until he found out I was not a government official and then he settled back on his own dignity and took no further notice of me. The cap is evidently a false color and I shall ship civilian top hamper tomorrow before I sail."

Upon reaching Port au Port, Newfoundland, he wrote on June 3, "We left Sandy Point in a schooner on Monday at about 9 A.M. and arrived here at 2 P.M. Usually it takes only two hours but it became calm and we were delayed. On our arrival at the Romaine's I found a hearty country welcome and enjoyed a day and a half there exploring the rocks, etc."

Mrs. Hyatt wrote from Hancock, N. H. on June 10. "Hattie is out sketching and Allie is in search of a Pee-wee's nest. He is getting quite a collection of eggs and insects together.—Just had a note from Mr. Gardiner dated from Negro Harbour on the 5th and the same mail brought me the enclosed (newspaper) notice. I send it because you may like to see how your Expedition looks in print.

"June 17. The Cape Ann Advertiser comes today with an account of the yacht's mishaps. I enclose clipping. I wonder if it encountered such heavy weather. I feel safer now that I know the pilot is on board.

"June 23. In a paper today I read of 80 vessels destroyed and damaged—counting back I find this storm occurred before the *Arethusa* reached Port Hawkesbury and was just contenting myself when I read of a more recent storm which I try to believe came also at a time when the yacht was safe in harbor.—Get all the cephalopods (Hyatt was the leading authority on fossil cephalopods, the animal group to which the nautilids, ammonites, octopi, squids, etc., belong.), squids, and photos that you need

this time, for I am sure I can never let you go again. Today came a pamphlet entitled, *Beitrage zu einer Monographie der Ammoniten-gattung Harpoceras* by Emil Haug, in which you are constantly quoted but evidently much differed from. With it was his extract in the *Bulletin de la Société Géologique* in which he has something to say against your 'subgenera'."

Upon joining the advance party, Hyatt wrote, "On board *Arethusa*, Bay of Islands, West Coast, Newfoundland, June 27, 1885. Since I wrote you last I have met the *Arethusa* and found her in good trim but still a little the worse for wear. She had had a hard time of it—six storms and squalls in fourteen days. She was greeted by one of the very hardest at her entrance into Port au Port. I was so rejoiced to see her that it was really blissful. She arrived some three days after she was due and as there had been some very heavy storms I had begun to fear she was lost. We had a good time in exploring the West Bay of Port au Port.—My collections made at West Bay and East Bay, Port au Port are superb.—All are well on board and the crew is even better as a working crew than on the Anticosti expedition.

"Old Port au Choix, July 19, 1885. I have been very successful and have on board a splendid collection of fossil cephalopods. These forms are in this locality very abundant and Barton (George Barton, a colleague of Gardiner, both being instructors

at the Massachusetts Institute of Technology.) and I have been very industrially gathering them for some ten days.—It is altogether the most favorable coast for geologizing that I have seen in North America. Mr. Bartlett (Sidney R. Bartlett, student at M.I.T., and photographer for this expedition) has taken a number of pictures but the atmosphere is not favorable for this kind of work since the distances are apt to be misty. Our daily life on board is about the same as on previous voyages except that we are nearly all the time in harbor and land about every day.—Write Van Vleck that we shall be home probably promptly on time.—I am too homesick just now while sending this off to trust myself to write as I feel before these youngsters. No man knows how deep this feeling is until it shakes him as it does me now."

1. Thanks are due Mrs. Harriet Hyatt Mayor and her son A. Hyatt Mayor for the privilege of searching "Seven Acres" at Annisquam for historical documents and for permission to publish the photographs and excerpts used in this paper.

LITERATURE CITED

- Burbank, J. B. and R. W. Dexter. 1954. Excerpts from Alpheus Hyatt's log of the *Arethusa*. Essex Institute Historical Collections, 90(3): 229-260.
 Dexter, R. W. 1952. The Annisquam Sea-side Laboratory of Alpheus Hyatt. Sci. Month. 74(2): 112-116.
 Dexter, R. W. 1954. Three young naturalists: the first expedition of Hyatt, Shaler, and Verrill. Sci. Month. 79(1): 45-51.

NEITHER SNOW, NOR RAIN, . . . OR THE POSTMAN RINGS ALL THE TIME¹

by David Causey

One of my former students, by no means as bright as he might be, wrote the other day, "Sometimes I envy you your teaching career. It seems that it would be so peaceful and dignified." Now I'd like to make it clearly understood that our student raw material comes to us unassorted and that the results must be judged accordingly. I refuse to take any responsibility for this man's naivete. He could know better, and he doesn't. And what I replied will be a deep secret unless some melancholy day some scavenger collects my letters to blacken my memory. Personally, by and large, I regard my teaching career much as a man, while drowning and coming up for the proverbial third and last time, hears some one on the bank say enviously, "Brother, it sure looks cool out there!" Punch's famous advice to those about to be married applies.

It (the letter) got me to thinking about my mail. It comes in a flood—a spring tide, if you know what I mean—and much is what my friends at the post office call "throw away mail," stuff one drops in their great waste can without ever opening. I am on eleven different mailing lists from the same book of the month club, and even sedate Macmillan's has me on three, with my name variously misspelled. The residue, what I open and look at, is somewhat reminiscent of the sludge in a misbehaving septic tank (and I hope you don't know what I mean). The worst of all is the academic mail.

I teach in a small state university. While I don't have the latest official statistics at

1. Dedicated to Mrs. Dean G. D. Nichols with my best regards and humble thanks for the idea.

hand, I would venture the guess that we have about 150 students and faculty and some 4,000 administrators. These are largely deans and vice presidents. They are outside the law, as I hope Kipling once said; we speak to them only when unavoidable, and they know it. The only common ground I've found between students and faculty is the opinion we hold regarding them.

It's a day rarer than one in June when I don't get a request, which is an order couched in what the administrator hopes is scholarly, academic words but is always a bureaucratic insult, to supply a few pages of information he already has on file in his office. The Vice President of Sound and Fury may need to know how many students I have in each class, where they meet, for how long, and why. That there was a printed schedule at the beginning of the semester, that each change in it was announced during registration again and again, and I almost forgot, again, that the only persons actually concerned—the students and the teacher—already know all this—all this is of no significance.

The choicest gem of purest ray serene is the request for personal data, usually referred to (if his secretary had Latin in high school) as "The Vita." The Dean of Laboratories or of Rat Hole Engineering gets stuck with his cross-word puzzle (Do you know a three letter word for a feline animal found in alleys at night?), gives it up, and to pass time away, orders up a new edition of *The Vita*. It comes to me in the campus mail and wearily I resist the impulse to inquire of him if he has ever heard of Who's Who in America, American Men of Science, or any of the regional student books. I write another *Vita*:

"Stillborn, Jan. 20, 1899. Alton Illinois. Public schools, Greenville, Illinois and State Refrom School, Pana, Ill. Graduated from Greenville High School (expelled twice). B.D., 1921, James Millikin University (after parole from State Penitentiary (Manslaughter—a dean). M.Sc., 1922, University of Illinois (Domestic Science). Leavenworth University, 1923, no degree (bigamy and arson). D.D., 1925, University of California (Feather Engineering). U. S. Army, 1847-1848 (dishonorably discharged). Ambassador to Erewhon, 1926. Professor of Zoology, University of Arkansas, 1928; Instructor of Zoology, 1945. Died, with medical supervision, of academic anemia, 1948. Member: Order of Cincinnati (Founder and first President); Static Club. Republican and/or Democrat. Home address: City Jail, Fayetteville."

I feel a little sad as I type it, there's an item or two I regret, but like Cromwell, I want my wart on my face—you can't have just part of me!

Little sketches of that type have come from my typewriter for nearly thirty years, and gone to every administrator who has

a filing cabinet (joke, son.). I've given my birth as every year from 1492 B.C., to A.D. 2500; I've elected myself to every organization I've heard of or been moved to invent; I've granted myself all known degrees from most of the seats of learning I listed Hamlet as one of my publications when an English professor was dean, and claimed to have invented The Calculus when a math man set in the seat of the mighty. Only once have I been close to being caught. A dean had a new secretary who read the stuff they got and she inquired about my B.V.D., Harvard (1870). I corrected it to Yale (2001) and she let it lay, as we say when shooting craps.

There's another type of mail. Sometimes I get a chance to get in on the ground floor for some Erie Canal stock, or ditto for a firm manufacturing chromium plated ox shoes. Once, a high tide in my mail, I got a Spanish Prisoner letter from Mexico City, and I still have it with a letter from the Third Assistant Postmaster General. They are in my archives this very moment. I still wonder about that beautiful daughter who would meet me in El Paso (my wife stopped that angle). If I should drop my habitual, serious mien (that's a good, four letter word!), as I did once, and write an article in a lighter vein—my mail picks up. I quote:

"Dear David Causey:

"In the May 1953 Bausch & Lomb Educational Focus publication appeared your delightful discourse on:

The Decadence of the Male

I think that this article is worth printing in a small booklet in a limited edition of several hundred copies. It could be printed on fine paper and also with a paper cover. I could also send you as many copies as you wish for your own use. Another thought would be to add some woodcut illustrations for extra color. Maybe you could make a few sketches and I will have a local wood engraver cut the blocks. The booklet would be given away to acquaintances . . . but if any unknown "Decadent" male would want a copy we might ask a nominal price in order to hold down the requests.

"A footnote in the B&L article states that your piece was first published in the *Biologist* in unexpurgated form. We would want the full original text . . . along with any additions you may have thought up by now. What is the address of the *Biologist*? I would like to write for a copy . . . if you will give me the date.

"I think that this reprint would become a nice conversation piece and who knows . . . maybe even a future classic!

"Looking forward to hearing from you,
"Sincerely,"

I swear that's a faithful, line by line copy, nothing added or omitted.

I replied, and again I give an exact copy:

"Dear Mr.

"Thank you for your wonderful letter. By the time I had finished it I felt we were practically in the second edition. I suppose it is bad manners to be so inquisitive on so

short an acquaintance, but have you ever sold oil or mining stock?

"I suppose you are what we lovingly call a vanity publisher. If I am correct in this assumption, let us terminate this correspondence with this letter. I wouldn't invest a dime in my collected works—you might note I'm not even paying the postage on this letter.

"If I have wronged you, and you are a legitimate publisher who risks his own money, let me hasten to inform you that the article you admire so much is merely one of

a considerable series. Instead of your publishing a mere booklet you could bring out a nice sized volume, and that way you could lose ever so much more money. I believe it would be deductible from your income tax.

Yours truly,
David Causey,
Professor of Zoology

P.S. Somewhere in Miss Post's wonderful volume you could find out how to address a dignified professor at a great institution."

And as Maude Adams used to say,
"That's all, there isn't any more."

BIOLOGISTS OF ALEXANDRIA

by Lester P. Coonen, Ph.D.
University of Detroit

The death of Theophrastus in 287 B.C. marked the end of pure biology in Athens. In fact, it signalled the passing of intellectual primacy for Greece. This was the fateful formula: Science had been mothered by Philosophy; now Philosophy showed signs of deterioration. Sciences suffered imminent starvation, for there was little to nourish them in Epicurean and Stoic philosophy—and these were the schools of philosophy now in vogue. The crucial defect was the lack of desire to know the how and the why of natural phenomena. Practical and applied science took over. (1)

Pragmatism, however, was merely a symptom. Much had happened and was happening to Athens and her people, and to the outlying lands which engendered and sustained the great city. No doubt the chief catalyst in this ferment was Alexander of Macedonia. To understate the situation, he was setting politics and economics askew in the whole of civilization. Greece had already toppled. Her independence had been forfeited to Philip, Alexander's father. Despite his generous peace terms, freedom had vanished, and degenerative social changes had been set in motion. Add to this the debilitation of recent internecine wars and the ravages of a new disease, malaria.

(2) Anopheline mosquitoes were well established tenants in Greece, but now they carried a new and sinister cargo. Malaria became endemic here by the middle of the 4th century B.C. (3) Thus the triumvirate, War, Malaria and Politics had gradually changed Greece and her Queen City, Athens, to something less than the political dominance and moral force necessary to command the restless world. Her halcyon days had passed. Indeed the Academy and the Lyceum were still great, but not great enough. Their influences, somewhat attenuated, were still felt in the world and would continue to inspire and direct the minds of men in the Middle East and in the West for

millenia to come. But the original spawning grounds were drying up.

Alexander, surfeited with power and wealth, bored with the lack of military resistance, and excited by prospects of civic and political monuments, ordered his engineer Deinocrates, to lay out a new city on continental Africa. Previously he had named a city, Bucephalia, after his favorite horse; another, Peritas, after his favorite dog (4). Naturally, this one would bear the conqueror's name, for it was to be the light of his new empire and the center of its power. Such was the plan: this was a new kingdom; there would be a succession of heirs; there would be an arrangement of power and the necessary devices to guarantee its perpetuation. This was in 332 B.C.; Alexander was but a youth of 24. Who would conjecture the fateful schedule of major events made ready for execution?

Alexander was to enter the adolescent city but once more—to be buried, nine years later (323 B.C.) Since he was to leave no adequate heir, a knotty problem of succession was immediately at hand when he died. In less than a generation (305 B.C.) his four generals would have completed, in strife and suspicion, the division and allotment of the world kingdom. Those events happened on schedule. To Cassander went Macedon and Greece; to Lysimachus, Thrace and Western Asia Minor; to Seleucus, Syria—eastward to the Indus. And to Ptolemy went Egypt, including the new and thriving city of Alexandria. In general, the effects of the new political arrangement were wholesome: a) old trade barriers went down; b) commerce flourished; c) great and stagnant fortunes were liquidated; d) Attic Greek became the important language; e) each new monarchy radiated Greek culture; and f) literature flourished (5). Several libraries were started. For the period 1100 Hellenistic writers are recorded. It was a long and flourishing era which ex-

tended from 323 B.C. (the death of Alexander) to 146 B.C. (the destruction of Corinth by Rome).

For our purposes this was virtually the formalizing of the transfer of the seat of learning from Europe to Africa, from Athens to Alexandria. For as Athens subsided intellectually, by about that much did Alexandria rise. Fortunately Ptolemy Soter and his successor, Ptolemy Philadelphus, were ardent sponsors of education, art and science. As Sarton (3) has said, "The forest was burning beyond help but some of the seeds had reached . . . Alexandria." The influence of Athens had been and still was unmistakable, and it was good; but the fourth century. B.C. had been its century. Although some pursuits, such as historical research, continued there for some time, the Lyceum and the Academy were soon to be overshadowed by the influence of Alexandria's incipient Museum. Complementally, Alexandria was to have its intellectual and cultural apogee and the attendant admiration of world scholars. Again, as the fourth century was Athens', the third belonged to Alexandria.

In 294 Ptolemy I imported the Athenian scholar Demetrius of Phalerum, a former student of Aristotle, to establish the Alexandrian Museum (dedicated to the muses). In many ways it was to be the greatest of ancient institutions of learning. By mid-century it was flourishing. Scholars and students from all over the civilized world came to this fountainhead of intellectual vigor and Hellenistic spirit. The institution was sizeable; its equipment was commendable; its organization was new and unique—perhaps more like a great university than anything contrived by any other ancient people. Strabo's (c.25 B.C.) description outlines a picture: "The Museum too is part of the Royal Quarter; it contains a promenade and arcade, and a large building in which is the common dining room of the scholars who are members of the Museum" (6). Here were two library buildings, lecture rooms and laboratories (5). Here scholarship and research abounded in a climate that was self-perpetuating. For at least a century Alexandria was unsurpassed. Her libraries were most complete and her scholars most renowned. By the year 280 Callimachus, the head librarian, had catalogued and briefly biographed the then current authors in 120 volumes (5). The project was hardly an idle scholar's pastime; it was a stark necessity, for the library had 90,000 works in 400,000 volumes (= "rolls"). The writings were the intellectual treasury of the four departments of the Museum. They were treatises on literature, mathematics, astronomy and medicine (5). Even though these papyrus

rolls comprised the real scholarly attraction (6), we might remember that here sat the immortals: Euclid the geometrician; Archimedes, the mathematician and engineer. Here toiled Hipparchus and Eratosthenes, the astronomers (not all at the same time, however). And here thrived the great anatomists, Herophilus and Erasistratus. It is pertinent that oratory, rhetoric, and even philosophy were not nearly so important as science here.

We need to remind ourselves that the setting was Egyptian. Thousands of years of Egyptian traditions—some valuable—could very well have contributed to this new venture (7), yet the key personalities were Greek or Asiatic Greek. The medical bridge, perhaps narrow and only slightly used, led from Athens whence it extended much further back to the Ionian island of Cos. Along this passageway, at Athens, had stood Diocles, representative of the Dogmatic School of medicine. He and his confreres (4-3 centuries B.C.) had made medicine conform to the waning influence of the Academy and the Lyceum (3). He added to early human embryology, obstetrics and gynecology, especially by describing the placenta, and further by dissecting the uterus of a mule. In general, he helped prepare the way for the Alexandrian anatomists.

Only the lack of proper communication kept Alexandrian scholarship from scattering its light farther into the outlying darkness. The library rolls were hand-copied and usually no more than one of a few copies in existence, and often the only one in the world. Scholars came to the library; they established residence in the city for a year or two, or more, to use the invaluable manuscripts. All of this promoted and necessitated a state publishing business. Just as Pergamum in Asia Minor had at one time (200-150 B.C.) the necessary sheepskins and skilled technicians to produce parchment (named after the city) and to become the world center for parchment manuscripts, Alexandria had an even better situation at this earlier time. She became the center of papyrus sales and consumption. Neighboring marshes of the Lower Nile conveniently supplied the reedy plants. Though of limited supply, the material was cheaper and much more available and expendable than parchment ever was to be. Thus papyrus was an economic substance and a very important one, upon which Alexandria's great cultural center depended. "Books," which were actually one-sheet rolls, took constant punishment at the hands of scholars. Hands, sweaty and oily rolled and unrolled these cumbersome documents. When in use the inscribed lines had to be closely followed with a guiding finger

to defeat the inadequacy of flickering lights from burning oil or fat. Naturally, such frequent contact obliterated words or phrases and made frequent recopying necessary. The royally endowed Museum and Library studiously supervised copying of the worn rolls and reproducing any new work brought to the city. The faults of the primitive system are obvious. It was a deterrent to scholarship, especially to the repetition of anatomical illustrations. After the copyist received his impression of a word, sentence, paragraph or illustration, he tried to copy it; often he unwittingly interpreted it, slightly modified it, while he painstakingly represented his version anew on papyrus. Errors, ambiguities and elisions were bound to make cumulative revision and modification an unwanted degeneration over the decades. But this was the situation; it was the best system available.

Despite these corruptions and weaknesses, fairly complete works and sizeable fragments have come down to us, making much sense and evoking commendation in all who read them. The whole Hellenistic movement in Alexandria produced little pure botany or zoology. Primarily the contributions were in anatomy — human anatomy — and they stemmed directly from the medical school. Biology was subservient to medicine (1). It is a truism that whenever and wherever this relationship exists, biology is human biology, usually nothing more. Human biology is good in itself, but it is only a narrow portion of the whole, instead of being the capstone to all the other supporting disciplines of biology. Aristotle's zoology and Theophrastus' botany, highly developed and ready, were not further extended. In fact, they were ignored and virtually set aside. One positive result was the improvement of the medical curriculum, however, for anatomy became the central unifying theme of the whole field. It was a new source of validity, better than the superficial "organizers" previously employed.

An exception to the new trend in human biology was Nicander of Colophon (in Ionia). About 275 B.C. he wrote didactic poems on diverse biological subjects. He included metric discussions on medicine, agriculture, zoology and botany. The Athenians had done much better, generally, but his work had merit. Although 125 plants are mentioned and sometimes described, and although he pioneered in discussing leeches in therapeutics, his noblest contribution was in his textual approach to snakes. Venoms and their antidotes were considered at length. Although he excelled, his writings led to no further development; he had no avid disciples to go on with any of these

leads.

Another item of slight hope appears later, under Ptolemy II (reigned 485-247 B.C.). Extensive zoological gardens were laid out at Alexandria. Many specimens from central Africa were included in it (8). This led only to weekend zoology—passive, entertaining zoology. It did nothing to establish and foster chordate or mammalian studies in morphology, ecology, physiology or anatomy.

At Alexandria, however, progress in anatomy and physiology proceeded at the research level. It merits detailed review, for the work of two great biologists stands out here; that of Herophilus and Erasistratus. Their work is partly commingled and somewhat confused. We shall try to separate the respective contributions beginning with the elder man, Herophilus.

Herophilus

Herophilus of Chalcedon, in Bithynia, flourished in Alexandria about 300 B. C. under the patronage of Ptolemy Soter. Only his predecessor Hippocrates (fl. 400 B. C.) and his successor Galen (fl. 175 A.D.) outrank him among the physicians of antiquity. He is feted here, of course, because he was a great biologist — a great anatomist of ancient times and was the master mind and persuasive personality who forged a scientific discipline from diffused and dissociated anatomical studies of his day (9). His intellectual home was the Museum of Alexandria. His researches and studies were resolved into three standard works of his day: a) *Of the Eyes*; b) *On Anatomy*; and c) a handbook for midwives. We learn indirectly from the books, for they did not survive the abuse of Time. From the references of Galen, and through the skillful reconstruction of Herophilus' anatomy by the German Scholar K. F. H. Marx (10) we can appraise the man and his works.

Herophilus described the systems: vascular, gladular, nervous, digestive, skeletal, reproductive, and separately the liver (10). His grasp of physiology was limited, but it was studiously plotted and honestly definitive. He identified four great physiological ends with their corresponding anatomical structures: nourishment, the liver; heat, the heart; perception, the nerves; and thought, the brain (9). Of all of his descriptive anatomy, that of the nervous system comes down to us most nearly intact (10). He described the cerebellum and the cerebrum and distinguished clearly between them. He made out the three membranes (meninges) covering the brain; the calamus scriptorius in the fourth ventricle (so-called because of its resemblance to the writing instrument used in Alexandria); the torcular Herophili, a blood sinus still so named

in honor of him. Physiologically as well as anatomically important was his distinction between motor nerves and sensory nerves (8). And he noted the sharp difference between tendons and nerves (9), not previously known. He traced cranial and spinal nerves, and described those of the heart (10). Not only did he follow the optic nerve from the brain to the eye, but he dwelt on the anatomy of the eye, its coats (10), and the retina (9).

He named the duodenum (the combined breadth of 12 fingers); carefully described the liver, salivary glands and pancreas (9). He saw the chyliferous vessels (9) as well as describing the genital organs and naming the prostate gland.

His study of the circulatory system distinguished between arteries and veins. For instance, he noted that the former have walls six times as thick as those of veins (9). He traced the pulse to the heart (8) and was first to count the pulse with the aid of a clock (clepsydra) and to establish the strength of the heart by noting the strength of the pulse.

This was anatomical and physiological research; not mere repetition of what had been done in Cos or Athens. With difficulty we conjure up pictures of specimen procurement and the opposition inherent in the mores of his contemporary society, for dissection of human bodies was necessary. Obviously the extensive studies demanded more than desultory probing of one specimen. There was repetition, comparison, statistical analysis of many, with much attendant discussion, note-taking and conclusion-building. This made Herophilus immortal among anatomists and it made Alexandria great among the landmarks of civilization, for this was the celebrated birth and infancy of scientific anatomy.

Erasistratus

Erasistratus also immigrated to Alexandria. Slightly younger than Herophilus, he was born in 304 B. C. in the Aegean Island of Chios. He flourished in Alexandria c. 250 B. C. In the best tradition he was trained at Athens, where he may have worked under Theophrastus (11) and under Aristotle's son-in-law Metrodorus, and further under Chrysippus (9). He was evidently so competent that he was invited to the Museum, perhaps to set up a second or rival medical school.

In historical perspective his forte is physiology but in his own day he was also a first-rate anatomist, surpassed only by Herophilus. His biological literary efforts fill 62 books (12). In addition to these accomplishments, he was a great physician. His prestige here is vouched for by the fact that he had at one time served as court

physician to Seleucus I of Syria. We deduce now that he must have had a thorny personality. Not only did he wrangle with his confrere Herophilus, over technical points and priority in anatomical research, but even his successors were academically irritated by him. Galen (130-200 A.D.) directed professional scorn, sometimes unwarranted, toward his interred bones. He wrote two polemical treatises against Erasistratus 400 years after the Alexandrian biologist's death. An example: "Now Erasistratus is thoroughly small-minded and petty to the last degree in all his disputations . . . nay, he did not even hesitate to contradict those who maintain that the urine passes into the bladder in a vaporous state . . ." (13). On another occasion Galen has preserved by repetition, adorned with academic scorn, a fragment identifying Erasistratus with the first suggestion of a "cell theory"—a kind of flushed flight into immortality. Galen's unintentional endorsement: "He imagines that animals (embryos) grow like webs . . . each of which has woven on its end or margin, other material similar to that of which it was originally composed."

Despite his shortcomings and the denunciations of his detractors, Erasistratus legitimately deserves a prominent place in ancient biology. His anatomical studies are sometimes epitomized as extensions and refinements of those already done by Herophilus (8), but such constricted praise is inadequate. Like throwing open a window in a stuffy room, he cleared the fundamental thinking on anatomy and physiology by pointing out the interdependence, and hence the concerted action of organs. Elaborate branches of arteries, veins, and nerves were seen by him for what they are, in and about all organs. He improved on the description of the brain, using vivisection with its dramatic disclosures to sharpen his discussion on the function of cerebrum and the cerebellum. Like Herophilus, he distinguished and emphasized a basic difference between motor and sensory nerves. His studies on the vascular system brought refinements; his work on the structure and action of the heart and its valves were new and bold. In fact, he first named the tricuspid valve. The close association of heart and lungs was one of his favorite themes. More about their physiology later. He correctly described the essential and tricky activity of the epiglottis as it guides food and drink past the windpipe.

Erasistratus sometimes merits the generous citation that he is "the father of physiology" (5). Honorary paternity is often and hastily bestowed by historians of biology. It might be remembered that Herophilus defended with jealousy the untenable "hu-

mors" of Hippocratic physiology; it was Erasistratus, though, who planned and decreed them into oblivion (6). He was a physiologist too, and centuries ahead of his time, for his unit-plotting of an experiment was very rare and unusual in ancient biologists. He chose to work with the tough problem of food-and-energy, the physico-chemical equation of animal metabolism. He weighed a bird; kept it in a jar for a time without feeding; then he weighed it again, together with its accumulated excreta. He recorded considerable loss of weight. We cannot be sure what he was exactly trying to prove, but it was similar to the procedure used by Sanctorius (1561-1636) about 1900 years later. Sanctorius was renowned for ingenious attacks upon scientific problems: in one he weighed his own body in a delicate balance and proved that it loses weight by releasing invisible by-products.

Sarton (3) feels that Erasistratus was near to the discovery of the circulation of the blood. His real difficulty seems to have hinged on his acceptance and obsession of the pneuma principle of Empedocles (5). He suspected that the arteries and veins are connected, but he had, in his mind, the arteries filled with air. Indeed in the dissected animal these vessels are empty simply because the blood is pushed along even as the animal dies. His obsession and conviction that pneuma (air) was the principle of life and that it was distributed throughout the body to make it quick, left him no choice but to explain both air and blood coursing through the body. This he unfortunately tried to do. His description of circulation was roughly: 1) air enters the lungs; 2) thence to the heart to become pneuma (or vital spirit); 3) thence via arteries, to 4) the various organs; specifically that which passed through the brain became animal spirit, moved on to 6) the motor nerves (hollow!) which, in turn, extended to 7) the muscles. The muscles, according to him, swelled and shortened to produce motion! There was the whole plausible story, bent to meet the needs of the prevailing "pneuma" doctrine. It seemingly accounted for all activity between a quick gasp of air and the swinging of a fist that followed. Air was synonymous with life and motion—mostly nonsense to us—but it persisted under the guise of varying terminology, even in the writings of Descartes in the 17th century (15).

A lesser anatomist, Eudemus of Alexandria, (c. 250 B. C.) carried on after Erasistratus and Herophilus had passed their peak of influence. Eudemus was their disciple and, in a sense, their missionary. He extended their anatomical findings at least in skeletal anatomy, the pancreas, female

sex organs, embryology, and even on the nervous system (9).

Alexandria, under the Ptolemies flourished practically until the death of Cleopatra in 30 B. C., but science suffered an early inflation. Medicine slumped into elaborate symptomology and pharmacy deteriorated under the Empires. Dissection ceased; anatomical research stopped. The influence of early workers, especially Erasistratus and Herophilus, continued to nourish the work of medical teachers and practitioners for centuries, but after Eudemus all new contributions were lacking.

One bright spot remains. It was in botany. Plant terminology never developed beyond the meager labels instituted by Theophrastus. Hence descriptive botany suffered a spare existence, even among the rhizotomists and pharmacists who built professions upon plant knowledge. This paucity of terminology set the stage for a botanist with another talent, that of plant illustration. It was Crateuas, (fl. 100 B. C.). He too must have been a capable physician, for he was royal medicine man to Mithridates VI, King of Pontus, near the Black Sea. History is full of kings and their royal healers, but we shall remember this man for he did with artistic lines what language could not do without appropriate words. He carefully and accurately described plants (1). Practical requirements motivated him to prepare a "handbook" for training druggists and for aiding physicians in plant identification. His work was carefully done—even in color, according to Pliny. For centuries his illustrations were copied. Deterioration and corruption are natural enemies of compilers and copiers; yet the pictures that have passed down to us show fidelity and judgment in the representation of living plant forms. Iconography was yet to have its heyday (and its greatest corruptions) in later centuries, but a Greek had made this important start.

REFERENCES

1. Singer, Chas. Chap. "After Aristotle," in *The Legacy of Greece*. R. W. Livingstone editor. Oxford: Clarendon. 1921.
2. Bucksbaum, Ralph. *Animals Without Backbones*. Chicago: U. of Chicago Press. 1938.
3. Sarton, Geo. *A History of Science* ancient through the golden age of Greece. Cambridge: Harvard U. Press. 1952.
4. *Plutarch's Lives*. "The Dryden Plutarch," rev. by Arthur H. Clough. vol. 2. New York: Dutton, 1910.
5. Sedgwick, W. T. and H. W. Tyler (rev. by H. W. Tyler and R. P. Bigelow) *A Short History of Science*. New York: Macmillan. 1939.
6. *Cambridge History*. Eds.: Cook, S. A., F. E. Adcock and M. P. Charlesworth. Vol. 7. New York: Macmillan. 1928.
7. Sarton, Geo. *Isis*. 15, 1931. p. 358.
8. Cary, M. *Legacy of Alexandria*. New York: Dial Press. 1932.
9. Sarton, Geo. *Introduction to the History*

- of Science. vol. 1. Baltimore: Williams and Wilkins. 1927.
10. Singer, Chas. Chap "Medicine," in **The Legacy of Greece**. R. W. Livingstone, editor. Oxford: Clarendon. 1921.
 11. **Diogenes Laertius** (trans. by R. D. Hicks) (2 vols.) vol. 1. London: Heinemann.
 12. Ackerknecht, E. H. **A Short History of Medicine**. New York: Ronald Press. 1955.
 13. **Galen. On the Natural Faculties**. (trans. by Arthur J. Brock). Cambridge: Harvard U. Press. 1911.
 14. Robinson, Victor. **The Story of Medicine**. New York: New Home. 1943.
 15. Singer, Chas. **A History of Biology**. New York: Henry Schuman. 1950.

A CHAPTER FROM KITCHEN ZOOLOGY¹

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Let us look at zoology! There is vertebrate and invertebrate zoology, though nobody has seen the vertebrae of our science. There is also fundamental and applied zoology, physiological and theoretical zoology, fisheries and forestry zoology, entomological, mammalogical, ornithological, wild life, ecological, malacological, marine, intertidal, deep sea zoology and what not. But whoever heard of culinary zoology? Our kitchens use mostly fishes, birds and mammals, also some crustacea and mollusks, but there is not much of zoological interest in the use and preparation of cattle and pigs. Though one could claim that the breeding of fat pigs or beef cattle, with the only goal of putting them finally into the kitchen, might be called a chapter of culinary zoology. The only reason why this is not done, is that with our every day food we forget that some zoology is involved. But when we hear that the natives of Polynesia wait for the Palolo worm to spawn its eggfilled segment, in myriads at the time of a definite lunar constellation and to catch them for food; or when we hear that near Amoy in China a species of *Amphioxus* is so abundant that it can be strained out of the sand to be eaten, this is clearly a bit of zoological information, while being also culinary news. So let this type of facts be put under the heading of culinary zoology and overlook the tongue in the cheek of the author.

There can be no doubt that the first zoological observations were made, not by Aristotle, but by primitive man tens of thousands of years before our era in his search for edible animals. His mammalogy was the study of the habits of cave bear, elephant, the woolly rhino, the wild cattle in order to be able to kill them for the kitchen (if any). His entomology was the search for edible grubs or wild honey, his malacology the finding of oysters and mus-

sels as we see in the kitchen refuse heaps of later but still very primitive cultures. In the course of time this zoology of food animals became applied zoology, animal husbandry, fisheries zoology, oyster breeding, etc., which leaves for our kitchen zoology only what we might call outlandish food animals; though what is to the American outlandish e.g. frogs legs is an ordinary dish to the Frenchman, while the certainly outlandish dish of raw blubber of seal, walrus and whale is the eskimo's dairy fare. Kitchen zoology, then, is a very different thing for students from different nationalities. But let us not worry about definitions, especially when it is obvious, that we have the tongue in cheek when proposing a science of kitchen zoology, good only for some story telling.

Let us begin with some fish stories. There is no fish of greater zoological interest than the eel. It was still in my life time that the zoological world was startled by the discovery that eels travel thousands of miles to a definite spot in the greatest depths of the ocean to spawn and that a strange, completely transparent and flat pelagic creature is the larva of the eel, which before entering the fresh water transforms into a little eel which enters the river mouth by millions, known as the montee. But there is another zoological interest attached to the eel, namely the considerable independence of his muscular reflexes, which remain strong for a long time after the animal's death. Once in my younger days we were given by a friend, who owned a lake, a beautiful big eel of four feet length. When it was cut into pieces for cooking the individual slices started wiggling like mad. The frightened women folk hardly dared to throw them into the boiling water for poaching; but still worse, one of them actually jumped out of the kettle and when I came home for dinner, I found everybody shaken from such experiences. Many years later I learned how to prevent such happenings

1. From a paper read at "Ladies Night" in the Berkeley Club.

when I watched in Japan, where eel is a most popular delicacy, how the cook handles them. He takes a live eel out of a barrel and kills it quickly by running a sharp bolt through its brain simultaneously nailing the head to a board. With a quick stroke of a very sharp knife he cuts off within a second one half of the long body along the vertebral column and with a second lightning stroke he removes the entire spine, with the spinal chord, all so quickly that the muscular reflexes have no time to get started! By the way, the Japanese seem to be the only people who breed eel for the kitchen. Ponds are stocked with the above mentioned montée which is fed with silk-worm pupae collected from the silk spinneries. At feeding time the attendant beats his knife against a board and at this sound thousands of eels come to the spot to be fed, a wildly wiggling mass of intertwined snake-like bodies.

In popular language the way is not very far from fish to fowl, though few people would claim that these are the same kind of animals. Not so the clergy and the monks in the early middle ages in Germany. In season a game bird, known for its delicious flesh, was shot. But nobody had ever seen it nesting, the simple reason being that it flies to the Arctic for breeding. This was the barnacle goose. The not very exact old zoologists not able to find the goose's eggs declared that the barnacles, crustaceans of the class of Cirripedia attached to submerged marine rocks, were actually the eggs of the barnacle goose. Thereupon the clergy decided that this goose must be regarded as a fish, which could be eaten legitimately on fast days, which they did until the curia interfered and rectified the clerical zoology.

Zoologically speaking, between fish and fowl are found the reptiles. This group does not furnish much food for human consumption though a turtle, terrapin, is considered a delicacy in some parts of the country. But it is still meat only for the well heeled gourmet. Again the Japanese, who are inordinately fond of unusual food have started to breed turtles for the kitchen in flat ponds which must be so arranged that not only rats have no access but that the young turtles hatched in nests in the walls of the pond are kept separate from the parents for a year, because the loving mothers and fathers would eat them otherwise. More interesting than these small animals are the huge marine turtles of the Pacific which grow to 4-5 feet in length and many hundreds of pounds in weight. In the middle of the nineteenth century they were so abundant that they were a staple food on many South Sea Islands. A specially rich hunting ground was around the Bonin-

islands (midway between the Marianas and Japan). Here a group of English adventurers had settled with polynesian wives and the turtles formed a good part of their food. Actually they could even salt down large quantities of turtle meat which they sold to passing whalers as provisions. My own interest in this piece of culinary zoology stems from a visit to these remote islands, made in the interest of studying the remarkable case of human hybridization. At this occasion I had the wonderful chance of observing the propagation of one of these sea monsters. Soon after midnight a giant turtle appeared at the moonlit beach. With great difficulty she lifted her immense weight to the sand and at once proceeded up the sandy beach. It must have been very hard work as the animal breathed heavily and more heavily in moving and rested every few steps. After a long time she finally reached a point above the tidal line and rested here for a while. Now she began digging a hole with her hind legs, alternately shoveling with each leg while the body was straightened on the forelegs. From time to time she rested, exhausted from the hard work. Finally a deep hole almost two feet deep and one foot in diameter was finished and after another rest the egg-laying began, initiated by a release of slime. At this moment a Japanese fisheries official, in charge of breeding experiments, sat on the back of the completely uninterested animal, threw a beam of a flash light into the hole, put his hand in and intercepted each egg, of the size of a small hen's egg, but spherical, when it appeared. Thus he collected 250 eggs, without the animal noticing anything. Then egg laying ceased and the turtle rested again. Finally she got up and started filling the hole with sand and when this was done she carefully smoothed the surface. Now she returned slowly to the water but not directly, making a zig zag detour, clearly in order to hide her tracks from a predator. The next night she came again and was caught and killed. Her abdomen still contained almost a thousand eggs and huge quantities of meat went into the kitchen. I found it rather tough, while the eggs with a gallert-like egg white were not too tasty either.

Cousins of the turtles in the group of reptiles are the snakes. Large snakes are probably eaten by many primitive people, but a preference for poisonous snakes is probably not frequent. The waters around the Ryukyu islands (Okinawa) abound in one of those dangerous, flattened poisonous snakes, which one can see drifting on the ocean surface. Since old times these were caught and eaten in Okinawa (since the American occupation this has probably

ended). In grocery stores one could see bundles of dried sea snakes looking like four foot long black sticks hanging from the ceiling. I had them served at a banquet in a stew mixed with fat pork. I could not find out whether they were considered a delicacy (not to me) or, rather, as I suspect, an aphrodisiac. But how surprised was I, when years later I found in the most elegant food store of Santa Barbara canned rattlesnake, for which there must be customers. I wonder whether the idea is that a venomous snake must possess mystic powers of resistance which can be acquired by eating the flesh. Perhaps also the idea of eating an animal which is poisonous in a part of its anatomy tickles our sense of adventure, as I know from experience. In the seas around southern Japan one of the strange balloon fish abounds, which can blow itself up like a balloon. This fish, called *fugu*, is venomous and it is especially the blood and the bloodfilled liver which contain the poison. One has learned to bleed and prepare the animal so that the poison is removed. The picturesque town of Shimonoseki abounds with cafes in which only this fish is served and in eating it — it tastes like any fish—one has the spine tickling feeling that possibly the fishmonger was not reliable and left some of the poisonous matter.

Let us make now a jump to the invertebrates of which quite a number go regularly to the kitchen. But I am sure that many of the laymen who eat them, do not know where they belong zoologically or what parts of the animal are eaten. Few oyster eaters realize that they swallow a live mollusk with heart, brain, bowels and everything, or abalone fanciers do not know that it is the fleshy foot of a snail they are cherishing; eating a *frittura di calamai* in Italy few travellers know that they are gorging themselves with the sucker lined arms of a squid or cuttlefish; not to speak of the ovaries of sea urchins served among *frutta di mare* in Italy or, salted down, in Japan. This reminds me of a Japanese saying that one lives a year longer for each new food one samples. Actually travelling in Japan away from the beaten tracks one has a chance to contribute considerably to one's life span. At a single meal in a remote village of the west coast I added many years to my life by eating shredded and dried jelly fish, raw, fresh, thinly sliced blubber of a whale and a dish of cooked luminous squids. This latter dish has really an interesting zoological background. Zoologists had known for a long time a small squid which had been captured in the deep sea as a few rare specimens, possessing luminous organs as so many deep sea creatures do. One day Japanese

zoologists learned that from time immemorial each year in May at a definite moon phase millions of small squids appeared at a certain small strip of coast of the Japan Sea. They were hauled in by the millions, dried and sold as food in China. When the zoologists investigated, they were surprised to find that it was the assumedly utterly rare luminous deep sea squid which came up from the abysmal depths to spawn at the shore. It was a miraculous sight when we went out in a pitch dark May night in a row boat to where the huge nets had been laid. The water looked as if millions of small but very bright sparks were dancing around. The animals were there in such dense masses that one had only to dip one's hand into the water to grab one. Each of them twirled its long arms around like a tambourin player's sticks and the bright lanterns at the tip were the dancing sparks, while the dimmer organs on the body shed a mysterious general light. One could easily imagine how the depths of the ocean must be lighted by such and similar light producers. At dinner the next day I had a chance to prolong my life by many years, when these squids were served in a series of different preparations. But I must honestly confess that in this bit of kitchen zoology, I preferred the zoological part to the kitchen part.

For days the whole region smelled abominably while the myriads of animals in the catch were sun dried at the shore, to be exported later to China. Dried sea food is one of the staple merchandise in all far eastern markets, because it is the cheapest animal protein food, needed by the rice eating nations of the East, and anybody who has made it a point to visit these colorful markets can evoke for the rest of his life the typical smell of the places, a mixture of dry fish, boiling oil and, farther south, the Durian-fruit. The quest for protein addition to the rice diet is indeed a major factor in the eating habits of these people. Sometimes, in remote regions far from the sea people are willing to satisfy their protein needs in strange ways. Thus I found that in a remote mountain region of Northern Japan a popular protein food was — maggots of bumble bees. To find them in large quantities people had developed an amusing hunting method. They waited near flowers, like clover, for a bumble bee to appear and quickly pasted to its back a conspicuous wisp of white cotton. This marking made it possible to follow the insect on its flight back to the nest in the ground and to dig out the thousands of fat maggots. This sounds like a tall tale, but after all, the zoologist studying the senses of bees also mark them with a dot of paint. I succeeded by chance to find

these maggots canned in soya sauce and the label on the tin depicted in colors all phases of this hunt as described. For years I had two such cans on my desk and offered my visitors to join them in a maggot meal if they were willing to share a can. But I did not find a customer and finally gave the cans to a museum which had a zootechnical exhibit. Thus I still do not know how maggot rice tastes.

Perhaps the most outlandish food, which many of my readers have tasted, without knowing what they ate is the Chinese delicacy of birds nests soup. This is not at all a cook's fancy name but the correct description of an amazing dish, real birds nests cooked for soup. The genuine article is the

nest of a swallow, the salangane, which pastes its nests to the rocks in caves near the surf of the seas of Southeastern Asia. This nest is made of the saliva of this bird which dries into gelatinous shreds. How the Chinese learned to eat this rarity—which has indeed a delicious taste when cooked—is difficult to imagine. But few people who order birds nests soup in Chinese restaurants know that they are going to eat a bird's saliva. But if the idea appears nauseating, here is comfort: in the overwhelming majority of cases you will taste an imitation made of some flavored gelatinous matter, as the original article is very expensive. Thus we finish this selected chapter of kitchen zoology.

THE EGGS (TURTLE) AND I

by James A. Peters

"Of Sea-Turtles there are several forts, but we always account the green Turtle to be the Beft Meat. They have several Islands and fandy Bays, where they go to lay their Eggs: Which they do in different places at different times . . . In the Bay of Motines on the coast of Mexico, we took them ashore laying their Eggs. The 22nd (November, 1704) we anchored in the Bay of Martaba, under the mountains of Motines. Here we watered our Ship, and found in a small River a great many large green Turtles, the beft I ever tasted."

Thus wrote William Funnell in 1707, as part of his fascinating account of one of the voyages for legalized piracy made on the Spanish Main during the late seventeenth and early eighteenth centuries, when he was mate to Captain Dampier on a British privateer from 1703 to 1706. His abbreviated discussion of the egg laying of this particular kind of turtle, known scientifically as *Chelonia mydas agassizii*, is still the only detailed information available, as far as the Pacific Coast of the Americas is concerned. Professor Archie Carr of the University of Florida found it necessary to quote an author writing about turtles found in the Torres Strait in order to give information about this animal in his turtle book published in 1952!

The bay called Martaba by Funnell is now known as Maruata, and is located on the Pacific coast of Michoacan, a state in southwestern Mexico. Although well known to pirates and privateers, who found the steep beaches and rocky shores much to

their liking as hiding places, the area is forgotten by the world of today. It still looks much as it did to the earliest British and Spanish seamen, with the ruggedness of the mountains on one side and the roughness of the sea on the other preventing the invasion of civilizing influences. In the summer of 1950 the University of Texas started a complete survey of this remote area, studying it in a scientific method. The party sent out included anthropologists, geologists, geographers, biologists, and ethnologists. I was along as one of the biologists, with a special interest in the reptiles and amphibians. The region was chosen because of its isolation and comparative primitiveness. Macadam highways and railroad networks had bypassed it, and the airplane, that covered wagon of the twentieth century, had only begun to invade it. A few mining engineers found their way there, and the Aftosa Commission had sent their hoof and mouth disease specialists in there as into the rest of Mexico. Biological exploration had been confined to a half dozen men since Funnell visited these shores. My fellow biologists (two ornithologists) and I entered the area with high spirits, hoping to see much of biological interest, and we were not disappointed.

We found more than our share of the species we had expected to live there, quite a few of those we had hoped to find, and several that we had not anticipated at all. We saw rare and little-known species such as *Diaglena reticulata*, a weird, bony headed frog with a row of sharp spines around its lip, so uncommon that it does not even possess a local name. It is a not too distant relative of the tree frogs and spring

peepers we know in North America, and is found only on the Pacific coast of Mexico. But one of the most fascinating and what might have been the most embarrassing (for me!) experiences was with the giant sea turtles that still abounded on the Mexican Pacific, practically undisturbed since Dampier replenished his provisions with their flesh.

In August, after spending eight days in the higher portion of the coastal Sierra, in the little city of Coalcoman, we hired a string of mules and rode off to the seashore. Although it is only forty miles as the crow flies from Coalcoman to the coast, our mules lacked the wings of a bird (or anything else at all soft or feathery!). It took us almost three days to reach salt water. Once there, we spent a delightful, cool night at the light house on the Point of San Telmo, first watching the coastal steamers pass in revue. Then we spent the night sleeping on our stomachs, as befits those who have been three days on a mule. Early the next morning we started off along the coast, which runs a little east of southeast in that part of Mexico. The sandy beach is regularly interrupted in this area by long, fingerlike projections from the inland mountains. These fingers run down at right angles to the beach and coast and often extend well into the ocean past the beaches, forming the "Points." Riding down the beach is made rough by these limestone ridges, for they cannot be bypassed on the water side. One must climb steep, rock-strewn paths that rise as much as four or five hundred feet above sea level and then drop precipitously down the other side to the sandy beach. A short half-mile's ride brings one up against another stringer. There are no protected bays or coves along this coast; on the contrary, the sea beats remorselessly and eternally on the high sandy beaches. The aftosa commission for hoof and mouth disease found this out when it tried to land supplies on Funnell's beach at Maruata. Apparently their seamanship was not on a par with that of Dampier and Funnell, for only a few pieces of blue-painted board remained of the wreckage of their LST when we arrived at Maruata, the rest having long since gone as salvage into the homes of the coastal Indians. We pitched our camp on this piratical shore, and spent two nights there.

The situation of isolated beaches, protected on two sides by the mountain stringers, on the third by a heavy surf, and on the fourth by sparsely inhabited lowlands followed by a rugged mountain mass, is obviously considered a gift from Heaven by the green turtles. They flock ashore by the hundreds to lay their eggs in the sand of this natural nursery. The evidences of

turtle activity were everywhere on this hot August day. A broad, shallow groove in the sand, paralleled by a row of marks like those left by the treads of a tank, marked the place where a female had heaved herself from the sea. Her heavy shell had dragged through the sand, with her flippers working hard and fast to gain a push-hold in the beach. In a half mile stretch between two stringers I counted 472 such tracks, which would indicate that almost 250 individual turtles had climbed that section of beach with egg-laying their end and aim. Many turtles return to the ocean via the track they made on the way up, so I'm sure my estimate is not high.

With the arrival of twilight at Maruata, the turtles began to appear off shore, just as they had 250 years before, when Funnell stood and waited for the best-tasting turtles he had ever eaten. They craned their necks to look at the beach, and sculled about in the heavy surf. The first turtle was spotted at 6:30 P.M., and before long had been joined by three or four more. All stayed out beyond the first row of breakers. Finally, after the night had become pitch black, the first of them approached the shore. She was finally beached at ten p.m., after a tremendous buffeting about by the heavy surf. Several times what appeared to be a successful foothold was broken by a large wave, and the turtle was washed back into the sea.

After ranging up and down the beach, watching landing tactics, I located a large female in the low thorny scrub that grows behind the crest of the beach. We were about thirty yards from shoreline. She was throwing large quantities of sand about, with both fore and aft flippers. By 10:15 she had dug a hole much larger than her upper shell, and deep enough that she was not visible above its sandy edge. The hole was about six feet in diameter. After completing the hole, she began a series of exploratory movements with her tail, pressing it deeply into the sand. The hind feet moved rhythmically, with one or the other always covering the tail. Every few minutes she crawled forward a few inches, and re-buried her tail by jamming it straight down into the sand. By 10:22 she had crawled so far forward her head was at the front edge of the hole, and at 10:23 she began to dig.

All the digging was done with the hind flippers, in a most mechanical and rhythmic. Each foot reaches into the hole, scoops up a bit of sand by curling the toe inward, and is raised and braced at the lip of the hole. The sand on the foot is dropped, the foot is placed behind it, and the other foot scoops. As soon as the other foot is braced, the first foot is kicked forward with a vio-

lent motion, and the little pile of sand showers over the shell. This cycle takes from five to eight seconds, and is usually repeated six to eight times. Then she stops to rest. By 10:33 the hole was so deep that her toenails just scraped the bottom of it when her leg was fully extended. Seven minutes later she stopped digging, after enlarging the bottom of the hole by excavating the sides. This created a chamber with a narrower tube leading into it. She dangled her tail in the tube, and immediately the first egg was dropped, at 10:43. Now the eggs popped out like ping-pong balls from a factory machine, one every nine or ten seconds. They dropped into the hole and rolled about until every nook and cranny was filled. The last couple of eggs, which arrived at 11:03 P. M., were very small, and the final one had a spiral twist in its shell. The hand flippers immediately went into action, neatly filling the neck of the chamber and smoothing it down. The job was completed in six minutes, and at 11:10 the fore feet began throwing sand over her shell and the larger hole she had dug to lie in.

This was the beginning of the hardest job of the evening, that of camouflaging the spot. While there are few predators, with the exception of man, capable of destroying an adult sea turtle, there is a multitude of animals that knows how tasty a turtle egg can be. By far the greatest destruction of turtle life takes place before the eggs hatch. So Mrs. *Chelonia* now began to cast mountains of sand back with all four feet. Soon the original hole, which had contained the entire turtle, was filled to the brim with sand. The turtle herself was still in an equally deep and large hole, however, created by scooping out the sand she had thrown back. She continued these earthworm tactics for almost fifteen feet, keeping the hole about two and a half feet deep all the way, until 00:37 A.M., that is an hour and twenty-seven minutes. The original nest site was covered with sand and littered with sticks and other debris, and was completely lost to sight. She then dragged herself back to the sea, arriving at the water line at 01:10. I imagined I heard a huge sigh of relief as she swam straight way out to sea.

My fellow witness to the egg laying and I had long since lost count of the total number of eggs. I needed measurements on the dimensions of the nest as well as the size of the clutch, so we now decided to dig it up and check it. Although we had no tools for digging, we were sufficiently confident that we could find the nest with little trouble, so we went back and began to dig with our hands. We had both triangulated the hole, referring to nearby shrubs, so we

expected to turn up the eggs in a jiffy. Half an hour later we had excavated a hole large enough to stand in, with a wall of sand around us that constantly slipped back into the hole. We saw no sign of the eggs. Obviously, the old lady of the sea had done a little more clever job of hiding the nest than we had supposed. We called a halt, straightened our backs with a creak, and decided to return to the camp for digging tools. The only useful thing in sight were our tin plates. We resigned ourselves to the effort of moving sand with such a shovel, and returned to the nest. At first, about 2:00 A.M., the hole was large enough for only one of us, but it rapidly took on much more capacious dimensions. Soon it was necessary to fill the plates full and throw the sand high over the towering mound above our heads to keep it from sliding back in on us. We had now dug out as large a hole as the turtle had started with, and it was four or five feet deep. We couldn't judge the actual depth, since the mound around the edge was too high.

At three o'clock my partner straightened up with a grunt and a groan, and stood massaging the small of his back. It was too dark for me to see the pondering look in his eye, but his next remark proved it was there. He said, "Y'know, I don't really care how many eggs that confounded turtle laid, at all. I'm going to bed." I commiserated with him for a moment, gave him a leg up out of the hole, and started him on his way.

Although the mound was too high to watch him go, I listened to him crash through the brush, and allowed myself a few seconds of pure, green-eyed jealousy for him and his comfortable bedroll. I wanted little more than to collapse and sleep right then myself. I couldn't, however, because I am cursed with a too vivid imagination. The scientific urge to get as complete and accurate a set of data as possible played a part in my remaining to dig, of course. But an even stronger push came from the awareness that it would be extremely embarrassing to relate the story of the egg laying to any of my colleagues. I could picture the entire scene, as they listened to my detailed account of the passage of the turtle, the selection of a nesting site, the procedure of excavation, the hiding of the nest, and the return to the ocean. It was a pretty picture, but in my mind's eye someone invariably asked me, "Yes, but how many eggs did she lay?" And I could feel the shame of saying, "Well, I don't really know for sure." "Why not?" "Well, you see, I just couldn't find the nest again!" This was invariably followed in my imagination by a short but appalling silence, while they looked at one

another, and one or two poorly suppressed snickers sneaked out.

No, obviously, I had to find the nest. I dug with renewed vigor, and the hole became large enough to accommodate the Cardiff Giant. By four o'clock I had dug as much as I could without getting clear out of the hole and moving the mound on the edges back to keep it from sliding in on me. This called for a more efficient earth mover than a pie plate, so I scrambled out of the hole to catch forty winks, and then trap one of the other members of the party into helping complete the job. I crawled into my bedroll with sad misgivings that a skunk or some other moonlight marauder would beat me to the spoils—but the flesh was too weak to do anything about it.

I slept until the camp began to stir for breakfast, shortly before seven. It took only a minute to acquaint one of the geographers with the situation. The bait of fresh eggs for breakfast was enough to draw him to the scene of my "scientific" studies of the night before. Although the hole didn't look nearly as large in broad daylight as I had supposed it to be, it was still big enough to draw a few snide remarks about the expertness of our careful observations. The daylight showed up my triangulation points a little more clearly, so I decided to dig more to the south. After putting the geographer to work moving the sand back on the south lip of the hole, I jumped in and started scraping away on the south wall. Sure enough, a half dozen scrapes disclosed the first egg, in a nest that was a good three feet higher than the lowest level of my hole. From then on in it was easy. We counted the eggs as we removed them, with a final total of 125 full-sized ones, two smaller ones, and one with a spiral end. The nest proper was about ten and a half inches deep, and about a foot square. It had been completely filled, so she had deposited about a cubic foot of eggs. The top of the nest was fourteen

inches from the surface, which indicates that she dug to a depth of about twenty-six inches. The eggs themselves were from 1½ to 1¾ inches in diameter.

Having successfully completed my investigations, and prevented the embarrassment conjured up in my imagination, I felt the need of some gustatory researches. None of my companions had ever eaten turtle eggs before, nor had I, so we experimented with all the ways of preparing eggs that were practical in the camp. From this vast experience (I ate three dozen personally), I can say that boiling and poaching are not only unsatisfactory, they are impossible. The white of turtle's eggs is sufficiently different in its composition from that of hen's eggs that it will not congeal at all when boiled. I kept water boiling on one batch for three hours just to see if it would ever harden, but it never did. Our guide, whose home was not far from the beach, accepted our offer of some eggs with a happy smile, and demonstrated a methods of consumption that, while efficient, was not particularly attractive to me. The shell of a turtle's egg is not hard, but is quite rubbery and soft, as is necessary for them to be dropped into the nest. The guide would pinch up one edge of the egg, bite off this edge, and suck out the contents. He went through a dozen eggs in considerably less time than it takes to write about it, and with much more gusto and relish.

The eggs, prepared properly, can be quite tasty, however. I found that frying did not work too well, since again it was hard to get the white to solidify. If the eggs are broken into a pan, beaten into a lather to mix the yolk and white, some diced Vienna sausage or bacon is added, and the whole then scrambled in a well greased frying pan, the result is quite edible. Salt them while they fry, and serve piping hot. Although quite mealy in consistency, they taste not unlike hen's eggs. I think you'll like 'em!

With the world's population rising swiftly food supplies may soon be outstripped. One suggested solution is the increased use of food yeast and other molds.

HO-PING AND MOLD FOODS

by Dr. Alfred S. Sussman
 Assistant Professor of Bontay
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In these days of international tension it is well to recall that Ho-ping, the Chinese word for peace, means literally "food-for-all". Whether or not a full belly will temper bellicosity may be problematical but a condition of Ho-Ping certainly seems to be one prerequisite for a lasting peace. Unfortunately the food supplies of the world have not kept pace with population growth and, what is worse, the food consumption per person has fallen from its pre-war level. The answer may lie in an expanded and more efficient agriculture, and to this end our Point Four program has made substantial contributions. Still, such efforts are discouragingly slow in their effects and are limited in scope, so that new approaches are being sought. One such approach concerns the use of algae as food, and it is the purpose of this paper to describe another possibility, namely, the use of molds as possible food supplements. Since the bulk of our information on this subject has been obtained by the use of food yeast, most of the subsequent discussion will concern this organism, although some mention will be made of other possibilities among the fungi.

History and Characteristics

Although the biology of yeast was not intensively studied until the nineteenth century, the products of its growth and fermentation were known to the most ancient peoples. The word yeast itself seems to have been derived from roots expressive of the heaving motion of fermenting substances. Words meaning scum and lees in Low German were altered by the Anglo-Saxons to *gest*, *gist*, and *yst*—all having to do with seething and foaming. So it was that the fermentation of yeasts became part of the customs and languages of the ancients, as far back as the Swiss Lake Dwellers where bread, which seems to have been made with yeast, has been found. Moreover, references to the use of fermented beverages (probably beer) by the Chinese and Egyptians date back more than four thousand years. Even Noah, surrounded by water as he was — or perhaps because of this — seems to have made the most of his opportunity to drink things other than water. During the Middle Ages specialization developed in the manufacture of beer and wine, but little was learned of the basic reasons for the fermentation. A precocious glimpse of things to come was obtained by van Leeuwenhoek in the latter

part of the seventeenth century, when he observed yeast under the microscope. However, he thought that the yeast cells were merely the rearranged starchy particles of the grain which was used in making the wort which he was investigating. It wasn't until the researches of Schwann and Kützing in Germany, and the simultaneous work of de la Tour in France in the 1830's, that yeasts were definitely connected with fermentation. Thus began the great era of research in this field which culminated in the work of Pasteur, Buchner and the modern workers in enzymology and fermentation.

This work disclosed that the yeast cell is variable in shape, but in general is spherical, elliptical, ovoid, or elongated. The size of yeasts also varies, but the average cell is about 1/4000 of an inch in length. Groups of cells growing together on a medium like agar or gelatin produce characteristic colonies which sometimes may be used in identifying the organism.

Most yeasts reproduce by budding. In this process part of the cell bulges out at an end or on its sides, and a constriction appears. Soon the "bud" or "daughter" cell separates from the original or "mother" cell. This is the type of reproductive process which characterizes rapid growth in the yeasts. Another type of vegetative reproduction can occur in only a few yeasts, wherein the cell elongates and a cross wall is formed in the middle of the cell. The two parts then pull away from each other and complete the type of division called "fission".

These and other facets of the life history of yeasts ally them with the fungi, which are those plants that are not differentiated into roots, stems, and leaves and which do not possess chlorophyll. (See Emerson, *Scient. Amer.*, Jan., 1952 for a fuller description of the fungi.) The True Yeasts include about 2000 different species. Representatives of this group perform numerous fermentations of economic value but are also responsible for off-flavors and spoilage of foods and beverages. A yeast called *Zygosaccharomyces*, for example, is associated with the production of soy sauce and brandy, while species of *Willia* and *Pichia* play important parts in the secondary fermentations of wine. However, the large majority of economically important yeasts are contained in a single genus, *Saccharomyces*. This is a group of over 100

species and contains the yeasts which ferment Sake, cider, and some wines. *Saccharomyces cerevisiae* is the most important species and the yeast which is used in making bread, beer, commercial alcohol, and many other products.

Chemical Constituents of Yeast

Since large amounts of yeast cells accumulate as a byproduct of fermentations its potential as a food has been extensively investigated. The data in Table I have been compiled for the purpose of outlining the

TABLE I
MAJOR FOOD constituents of
representative yeasts

Constituent	Yeast type	Percentage dry weight
carbohydrate		
glycogen	brewer's	32.6
	baker's	30.0
cellulose (crude fiber)	brewer's	10.0
fat	brewer's	1-6
	Torula	10-38
protein, crude	brewer's	47.6
	baker's	52.4
	Torula	45-50
minerals, total	baker's	8.8
calcium	baker's	0.2
magnesium	baker's	0.3
iron	baker's	0.02
phosphorus	Torula	2.44

principal constituents of commonly used yeasts. These include baker's and brewer's yeast and *Torula*, one of the false yeasts, a species used by the British in the manufacture of food yeast. In general, the figures given are representative of yeasts used in commercial food preparations.

The carbohydrate content of yeast is low when compared with other foods, and it occurs mainly as glycogen, or animal starch, and cellulose. It is claimed that two ounces of yeast will furnish 198 calories which would not be of much significance in a normal diet, so that a carbohydrate supplement would almost certainly be necessary were yeast alone to be used as food.

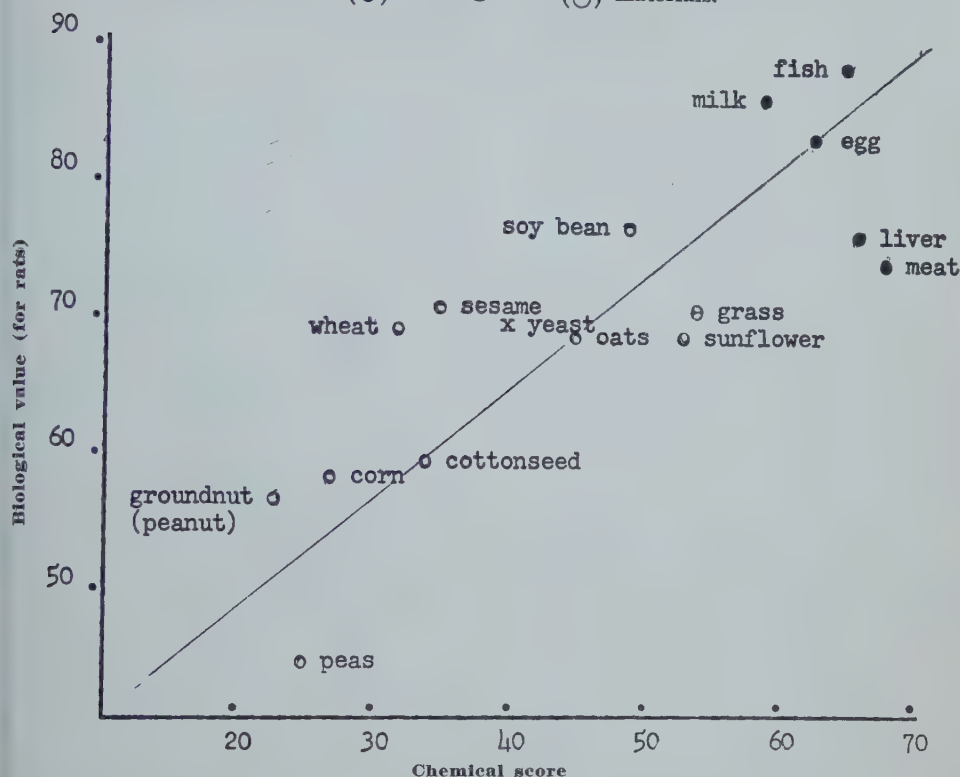
On the other hand, the commercial production of yeasts for their lipid content might be quite feasible. These lipid materials have been found to contain fats, free fatty acids, phospholipids and sterols. In fact, yields as high as 50% of the yeast's dry weight have been obtained from

some strains. The first world war induced the earliest large scale attempts to exploit microbes as a source of fats, and satisfactory commercial yields have been obtained by the use of several fungi and different starting materials. Analyses of yeast fat have indicated that it is similar to other vegetable fats except that it is low in hexadecanoic acid. It should be pointed out that such fats vary widely in composition depending on the fungus or even on the growth conditions of a single strain.

The protein content of yeast and other fungi has resulted in a large market for surplus yeast products as animal feeds and food supplements. Crude protein is obtainable in yields ranging from 40-55%, so that yeast is a rich source of this material. However, the analysis of the amino acid constituents of yeast proteins reveals that they are low in the sulfur amino acids, methionine and cystine. This is borne out by the results of many feeding experiments, summarized in the table, which shows that the nutritional value of yeast proteins is inferior to that of animal proteins. (See Table II.) In fact, when yeast was used as the sole source of protein in the feeding of rats a severe hepatic necrosis resulted. Although the exact reason for the development of this disorder is still in doubt, it seems to be due to an imbalance of certain amino acids and vitamin E. On the other hand, yeast proteins can be combined with a wide variety of other proteins and, when used in these combinations, may serve to enhance the biological value of inexpensive but inadequate foods like refined cereals.

The completeness of the vitamin complement of yeast is perhaps most dramatically demonstrated by the experience of the Dutch botanist, Dank, during the last war. While confined by the Japanese to a concentration camp in the Netherlands East Indies he spotted signs of vitamin deficiency in himself and other prisoners due to the insufficiency of their diet. He requisitioned 5 grams of rice from the meager rations of each prisoner and cultured yeasts, obtained from the nectaries of flowers, on this food. One spoonful of this material, produced under the most primitive conditions, administered daily relieved the symptoms of vitamin deficiency in the camp. Yeast preparations of various kinds are frequently used medicinally and as supplements which furnish the vitamins listed in the table. (See Table III.) Of the recognized vitamins that are required in the human diet, only vitamins A, B-12 and C are in negligible concentration in yeast. On the other hand, there are many unidentified factors present in this material whose exact function is not known but whose

TABLE II
CORRELATION DIAGRAM of the biological value and chemical score of animal (●) and vegetable (○) materials.



beneficial effects have often been noted.

Yeast Manufacture

In the past the use of yeast as a food was a subsidiary of the more familiar baking and brewing industries. Various extracts used as dietary supplements, and as medicines, are still prepared as by-products of the industries by spraying the liquid yeast

taken from fermenting vats into chambers heated by hot air. The moisture is then evaporated, reducing the yeast to a dry powder which is then packaged and shipped.

Recently, however, certain strains of yeast have been grown as food materials by processes evolved for this purpose. This has involved the development of a "seed" culture which is introduced as an inoculum into huge fermenting vats of the kind illustrated in Figure A, containing the substrate for the growth of the yeast. This may be molasses, sulphite waste, potato or straw mash, banana wood, whey and dairy wastes, wood hydrolysates, and even fern fronds. Commercial use has been made of only a few of these possible substrates but others might be economically feasible if the right strains of yeast or other fungi are sought. After approximately twelve hours, when about 1 billion cells per ml have been developed, the yeast is removed by centrifugal separators. This product is then run through presses, or dried as described previously, and packaged for use.

By this means, one 40,000 gallon fermentator delivers several tons of yeast

TABLE III
VITAMIN-B COMPLEX content of yeast and average daily adult requirements

Factor	Amount in yeast mg per 100 gm	Average adult daily needs (mg)	Dried yeast yielding average adult daily needs (gms)
thiamin	6-18	3.2	26.7
riboflavin	3.5-8	3.7	61.7
niacin	10-50	40	133.3
pyridoxin	5-10	1.5	20.0
pantothenic acid	2-7.5	11	220.0

daily. It has been calculated that 10 such fermentators operating over the period of a year can contribute the same amount of food, although not necessarily the same quality, as 60,000 pigs. Moreover, this can be accomplished on a few acres, with the equipment in constant use, and independent of weather, weeds, and insect pests.

Prospects and Prognosis

There seems to be little question but that yeast is an excellent source of B-vitamins and minerals and of fair quality proteins. In addition, these nutrients can be produced by growth on vitamin, mineral, and protein-deficient crops like cassava and sweet potato, or on numerous agricultural wastes. Moreover, the use of meat, poultry and eggs, although nutritionally preferable, is considered more wasteful of land than is the direct use of crops or their derivatives. This is made obvious by data which show that out of every seven calories of food eaten by livestock, six are utilized for heat, locomotion, etc., leaving only one for the conversion of feed to meat.

For many of these reasons, increasing use is being made of food yeast as a dietary supplement. A large number of experiments have proven the efficacy of mixing yeast with white flour, spaghetti, baby cereals, crackers, chocolates, and many other foods. In some cases the biological value of food proteins has been increased up to 75%. In addition, farmers are discovering that fungus feeds are both cheap and nutritious. Therefore, the role of food yeasts in this country seems limited to their use as a supplement rather than as a staple in the human diet. This is due to a complex of causes including the relative abundance of animal and plant proteins in this country and consumer resistance to new foods. Most people, if they think of yeast at all, consider it only to be an aid in pie baking or in curing Junior's acne, rather than as a potential source of steaks.

However, the use of yeasts in other countries may be quite another matter. Whereas

the United States has about 3.3 acres of arable land per capita, India, China and Japan have 0.78, 0.44, and 0.22 acres respectively. Even if their farms were highly mechanized, these countries with a total of almost 1 billion people simply do not have enough land upon which to raise the needed food. Under these conditions, "vertical farming" by the use of food yeast or other fungi might be a partial solution.

But if molds are to be suggested as a dietary staple, supplemented perhaps by a carbohydrate-rich food, what of the deficiencies in the amino acids noted above, and what of the large proportion of unsaturated fatty acids which make the processing of yeast fats difficult? The answer to these and to other objections to the quality of fungus foods seems to lie in the selection of the organisms to be used. For example, the molds *Fusarium* and *Rhizopus* are each reported to contain relatively high levels of cystine, methionine and glutathione when compared to yeast. In fact, the induction of mutations by chemicals or by radiations of various kinds permits the widest possible choice of organisms from which selections could be made for desirable nutritional characteristics.

Unfortunately, however, the very countries (with the exception of Japan) which most lack protein foods, are those with the lowest industrial potential. Such countries are the ones mentioned above, most of the West Indian Islands, and much of Africa and the Middle East. Since the efficient production of yeast requires considerable equipment and know-how, its wider use must await the cooperation of industrial nations. A. V. Hill has predicted that modern technology could adequately provide food for a population of ten billions, or four times the present level. Whether a microbial Point-4 program will provide the increment needed to feed a burgeoning world is of course unknown, but unless Malthus is to be proven right, new sources of food must be found, and it is the scientist who must find them.

A SCIENTIST LOOKS AT RELIGION

by Arthur N. Bragg

Based upon a talk to members of the First Presbyterian Church of McAlester, Okla.

When a scientist looks at religion, what he sees depends in large part on his conception of what is meant by science, on the one hand and by religion, on the other. Some scientists will say that all religion is a delusion, the misguided emotional response to a false hope engendered by reliance upon the literal or other interpretation of some of the stories, history and

poetry of an ancient, primitive and unscientific people, gathered and often translated and placed in one or more volumes, such as the Bible, the Indian Vedas, or the Koran. They will point to the conflicts in the many and various existant theologies, not only among Jews, Mohammedans, Christians and other great religions of the contemporary world, but also within denomi-

mations of any one of the great religions. There are sects in Buddhism, Mohammedanism, and Judaism but let's consider Christianity, for a prime example. The Roman Catholic Church has maintained for more than a thousand years that it alone is the church, founded directly by Jesus through the Apostle Peter (the first Pope) to carry on His work after the Crucifixion. All Protestant groups, however they may differ otherwise, agree in rejecting this interpretation of Jesus' intent when he told Peter that he was giving him the Keys to Heaven. Within Protestantism, as everyone knows, there are denominations which are quite liberal in their theological views (e.g. the Unitarians) and, on the other hand, those that say that a literal interpretation of the Bible is the only way to truth and salvation. Between these extremes occur many different intermediate ideas of the nature of God, of the Bible, of the intent and purpose of Jesus' life and of hundreds of more minor questions of procedure, proper use of rituals (for example, immersion, sprinkling or other means of baptism and the meaning of the sacrament (or ritual?) of Communion and other such matters). No scientists who think that all religion is a delusion, such conflict of basic ideas of the nature of Jesus, and of the meaning of religious rituals indicates that religious people have no real facts upon which they can surely rely. Otherwise, why do they come to so many different interpretations?

Other scientists take a different view. They say that there may be some truth in religion but that our Christian Churches of most or all denominations are so befogged by a mixture of fact and fancy that they cannot support them and at the same time maintain their intellectual honesty, an absolute prerequisite to all scientists.

A third group (and I think by far the largest) of scientists supports the religions of their individual choices in the belief that there is no essential conflict between religious truth, when properly understood, and scientific truth. Some of this group are church members and officers, actively supporting their church with their time and money; and, of course, there are many Jewish scientists similarly supporting their Synagogues. Others are merely passive believers, seldom attending religious services and belonging to no church family. What a scientist sees when he looks at religion, therefore, depends in part upon the scientist.

It also depends upon the nature of science and the individual scientist's conception of the basic nature of science. I once wrote an article on the nature of science intended for the use of young graduate

students in the sciences. While this was in preparation, I asked another scientist what he considered science to be. He said that science consisted of a method: and he implied that this method was different from the methods used in other disciplines. But when I asked him how the so-called scientific method differed from that used in other phases of scholarship he could not clearly tell me (or at least he did not do so). The fact is that there are several conceptions of what constitutes science even among scientists—and the people outside the sciences are still more confused. If I am to explore what a scientist sees (or does not see, as the case may be) in religion, I must first state my own views as to the nature of both science and religion and then relate the facts of both to these conceptions. I shall attempt to do this objectively, as a scientist should, i.e., to give a factual account uncolored by my own religious views.

Science is often conceived as the basis upon which modern gadgetry rests. Many people seem to think that the objective of science is better tooth pastes, automobiles, television sets, electronic devices of many sorts, dams, roads, etc. and, in recent times, atomic bombs and other weapons. This is the implication of much modern American advertising with which we all are constantly bombarded. The great scientist, in this view, is the one who invents some useful tool, making for safer or more easy living. The truth of this as the basic popular conception is often attested by rather insignificant things. For example, the U. S. Post Office a few years ago issued a series of postage stamps honoring famous Americans; authors, poets, inventors and scientists were stated to be among them. Among the five individuals selected for honor as scientists not one was a clear cut scientist as distinct from social workers, horticulturists, medical men and artists, although one might be considered a borderline case. All were fine people, worthy of the honor bestowed, but mostly for other reason than being scientists. And this, of course, is the point to my reference; few if any of these had, in the work for which they were thus honored, showed the essential characteristics of a scientific point of view.

We live in a universe which is orderly and we all put implicit faith in this order. We know, for instance, that if one jumps unsupported or falls from the roof of a building he will go down. We are sure that there is a relation of objects in the universe such that $2 + 2$ always equals 4 regardless of the language or symbols we use to express it, and also independent of abstract or "pure" mathematics. We also implicitly and unquestionably believe in the continu-

ance of the cycle of seasons, that spring follows winter and summer follows spring. We plant seeds with every expectation of getting plants of the type which produced the seeds and we do hundreds of other things that show our firm belief in an orderly universe governed by natural laws. To me, science is basically the attempt by ordinary human beings to discover this universal order in things. The utilization of natural laws discovered by science and expressed in various inventions is not science but technology, sometimes called applied science. Both are necessary and good but they are very different things.

Now if the objective of science is, as I think, to discover more and more about the order in the universe, it is well to ask how best to proceed to do it. And here is where the so-called scientific method of my brother scientist comes in. First, the basic thing in the scientific method is very simple — **merely observation**; directly by the use of the senses or indirectly by experimentation. Observation, experimental or not, gives facts in direct proportion as the observation is well done, accurate and not colored by wishful thinking or bias on the part of the observer. We often hear of an experiment which failed. There is no such thing as an experimental failure in science, if the experiment is well conceived and executed. Experiments "fail" only when we get an answer from nature which we do not want. If one wishes to know the color of an object and looks carefully and finds that it is red then he has a fact about this object. This is no different principle than when an anatomist, wishing to know the structure of an animal, dissects it to observe. Facts ascertained by observation are the building stones of science. And observation is the **only** way that scientists have for getting scientific facts.

But merely to observe is not enough. A mass of unrelated facts has no meaning; they no more constitute science than piles of bricks and lumber constitute a house. As in the latter case, they must be put together in an organized fashion, in this case through logic, to derive general principals from them. This is the way, and the only way, that science progresses. There is nothing mysterious about the scientific method.

From the above, one can readily understand that at any one time the body of science consists of three elements (1) known laws derived from observations, checked, verified and formulated into principles; (2) ideas and theories based upon insufficient knowledge to be considered proved; and (3) vague hunches, ideas and hypotheses of individual scientists which may or may not stand up in the light of

further facts to be found through further observations.

Now let us turn to religion. This is more difficult to define, for it deals with more intangible things than does science. It is a subject of many aspects and permeates all human existence. Before the dawn of history various groups of mankind had some sort of religious faith. Man is and always has been so consistently religious that I have long suspected that to have religious impulses is an integral part of the nature of man. Many atrocities have been perpetrated in the name of religion, especially by socially primitive peoples. Many people do not know, for example, that cannibalism as still practiced by a few tribes of men in various parts of the world is usually a religious rite, following from the belief common in the primitive religion known as animism, that eating part of the body of an individual (especially of a rival) assures that some of his envied powers will pass to the eater. But even in Christian Europe in quite modern times, the religion of the people of Germany did not prevent Hitler's pogroms for the German Jews. And Christians, especially, should ponder on the fact that it was basically a difference in religious conception which led Jesus to the Cross. And do not forget that even here in our own country, today, some of our citizens are not welcome in many of our churches because their skin happens to be black.

On the other hand, influenced by religion, man through the ages (especially some individual men) has reached heights of devotion and sacrifice of self-interest which live in the hearts of men through all ages of time. Even in their human mistakes we respect them and are stimulated to greater moral effort, for we recognize that their basic integrity and greatness of soul are among the highest and best things that man has yet attained. Such men as Isaiah, Amos, Hosea and Hillel among the Hebrews, Mahatma Ghandi of the Hindus, Cardinal Newman among the Roman Catholics and, in our own day, Dr. Albert Schweitzer, are some examples among many. Greatness of soul is no respecter of race, class or denomination.

What is this thing called religion that has led men to such heights of honor and greatness on the one hand but to such baseness on the other? Can we define it? At least we can try. To me, religion is the instinctive (or, at least, almost instinctive) search by mankind for something higher, purer and better than himself; something that he can cling to as an ideal to be striven for but hardly to be reached—a power so great as to be all pervasive of life and the universe in which life as we know it

exists—a Creator and stabilizer of the living. This is, of course, only paraphrasing what modern religious leaders all tell us—religion is a search for God.

Now, let us try to put these two concepts, i.e. of science and of religion, together and see where it leads us.

Science, I have said, attacks the problem of the what, where, when and how of the universe only by **observation**. Religion attacks the same problem by faith. Both use reason, speculation and inference. The what, the where and the when can usually be found at least approximately by observations, and therefore by scientists. The how, however, generally eludes them.

Take the problem of the origin of life, for example. Scientists have found that living matter of all sorts (whether in trees and other plants or in animals including man) consists of a complex jelly-like solution of complex and simple chemical compounds, ions and elements, known collectively as protoplasm, arranged in units of many shapes and sizes known as cells. But the protoplasm in different cells differs in different kinds of living beings and also in different cells within the same organism. Under the usual conception, the simplest of all certainly living things has but one cell in its body; but even here the protoplasm differs in what it does in various parts of this living speck, so small as to be visible only under high magnification. Life, in other words, now seems to manifest itself in some sort of organization peculiar to living matter which varies markedly in its expression in different times and conditions. These are scientific facts; but a basic question is raised by these facts, of interest to everyone regardless of how he is labeled—scientist, philosopher, religionist or just plain man. The question is, is this organization all there is to life?

Some have answered yet to this question and many scientists have been among the foremost of those who have done so. The implications of such answer, however, have given others opportunity to point out that those who look upon life as merely a complex organization of matter and physical forces have practically no evidence upon which to draw. An answer of yes to this question is not a scientific answer for no scientist can point to observed facts to prove it. It thus stands as merely opinion, no matter how prominent a scientist is who answers thus.

Those who answer no, scientists among them, face an equal dilemma from a strictly scientific viewpoint. They lack clear cut facts based upon observation to prove their point. The only really scientific answer that can be made to such a question is simply, "I do not know." And if we scientists do

not actually understand the basic nature of living matter, how can we state as fact how life came into being? The plain fact is that we cannot do so as **scientists**. As a human individual, however, one can accept either yes or no as his **opinion**.

People of modern religious convictions must answer no to our question, at least so far as man is concerned; otherwise there could be no human soul, no self-determination or free will, no true altruism, no love in the sense that St. Paul used it; the life and teaching of most great religious leaders, including Mohammed and Jesus, would become misguided myths without foundation; and even a Creator would necessarily be denied existence.

I repeat, **some** scientists affirm all this as their belief; but I also repeat that they are not expressing a scientific view point—only their own personal opinion, which, of course, they have every right to do. The religious opinion of a scientist, however, should carry no more weight **scientifically**, than one expressed by a lawyer, housewife or a blacksmith, because **scientists per se** have no more foundations for their religious beliefs than anyone else.

Now let us look **outside** science for other facts open to the experience of anyone. What prompts a man to risk his life in the attempt to save that of another? What is the appreciation of beauty based upon? What is it that makes the joy of giving greater than that of receiving? Science has no answer for these and other such questions. It is also completely baffled in trying to account for the order everywhere manifest in nature. If there were no order, there could be no science; for what science does is to try to find the order already there—and that is all it can do. The **explanation** for the order in nature is completely outside scientific experience. Science can discover that the order is there, **what** the sequence of events in that order is, **where** and **when** to expect change in a cyclic situation—the **what**, the **when** and the **where**, but never the **how**.

Now this is where religion enters the picture. Seeing the order in nature, always dependable and certain whether we understand it or not; seeing evidence of human love and understanding in their own lives and in those of others; despite much evidence of stupidity, greed and selfishness in man, seeing him rise above self on occasion after occasion; seeing beauty in nature at all seasons and in the growth and development of children; and knowing that others also appreciate these things as expressed in music, the graphic arts and poetry, modern man develops faith that there must be a higher Being, the eternal cause and stabilizer of the universe which He made

and of which we all are a part. This is the basis of religious faith and it is so basic to religions that Mohammedans, Christians and Jews share it. The God of the Christians and Jews is essentially the same eternal Being as He who is known as Allah by the Mohammedans. Where these three great religions differ is in different interpretations of some of the facts of history.

Science is no more certain of its facts than is religion. But within its sphere, the interpretation of these facts correlated by reason uncovers the order in the physical universe which, when it can be expressed mathematically, all are forced to accept as true. Religion, on the other hand, deals with more subtle facts whose interpretation is not on so sure a foundation as those of science. Hence the many theologies, denominations within religious bodies, and markedly different opinions on many religious questions which have developed.

What this all amounts to may be summed up rather briefly in the following few words. (1) All agree that there is order in nature. (2) Science attempts to find and to describe this order. (3) Technology attempts to use the order for the needs of mankind. (4) Religion looks for the ultimate source for the order through faith in God built up from undoubted facts of human experience of such nature that science can neither measure them nor observe them critically.

Science and religion are, therefore, supplements and complements of one another and deal with different phases of life. Religious experiences are real but they are outside the province of science. Religion, on the other hand, can, if it will, make use of the order in nature discovered by science. Indeed, I think it must do so to develop a true theology. Neither science nor religion yet has the whole truth.

There is within science constant conflict of theories and ideas. Similarly within religion there are conflicts in basic theologies, dogmas and ritualistic expressions. But there is not and never has been a real conflict between science and religion for they deal with different aspects of life. For this reason, I think I can consider myself, for example, both a scientist and a religious man. And anyone can do the same.

I would like to close with an account of a very peculiar personal experience which I had a few years ago for which I have no explanation to offer, either religious or scientific. I tell it as an example of an experience whose explanation may be in either the scientific or the religious field and is almost certainly in one or the other.

Many years ago I was a student and graduate assistant in biology at the Johns Hopkins University, Baltimore, Maryland.

While there, I came under the influence of a very great man, the prominent physiologist, Dr. Samuel O. Mast. Dr. Mast seemed to take an interest in me and he taught me many things other than the course in physiology which I studied under him. While I was there, he found that I had an interest in a relatively new research problem in his field, he encouraged me in this and I made a few preliminary observations under his direction and advice. I was at Johns Hopkins only one school year because circumstances in my personal affairs made it seem advisable to accept a university teaching position (my first) which was offered me. After a year or two in my new position, my interest in my research problem was again awakened and I had correspondence with Dr. Mast, seeking his advice by mail. His few letters were friendly and helpful and I spent a little of my time each year thereafter on this problem but did not really do more than preliminary studies for eight years. Then I was able to settle down (now in another institution) and study the problem more fully. This resulted in a major and two or three minor scientific notes published after I came to Oklahoma. I never saw Dr. Mast again. He died several years ago.

Shortly after I learned of Dr. Mast's passing I received in the mail a large envelope. On opening it found a reprint of the last scientific article which Dr. Mast had written, sent to me by a former student of his who had been appointed to see that this article was distributed to the proper persons. The subject of the article indicated that the last research of my old professor was on the subject of my more feeble attempts at research. I, of course, sat down to read it with great interest, alone in my office.

Reading along, totally absorbed in the subject, suddenly I felt as though someone was standing just beyond my desk and it seemed to be Dr. Mast, wearing the kind of smile which I knew he would have had he caught me reading his article, although I saw nothing when finally I looked up. Several years later, I met a former student of mine who had been at Johns Hopkins when Dr. Mast passed away. Without knowing this story, he told me that Dr. Mast had talked about me and my work many times, the last time just the day before the old man died.

How can this experience be explained? A scientist would be likely to look upon it as a psychological hallucination on my part. Indeed, had I heard this story from most people, I, myself, would favor this view. And of course it may be the correct one. I would point out, however, that I hope and believe that I am too good a scientist

not to understand the nature of such things and I am not usually one to be carried away on any kind of emotional spree, at least not without recognizing what is happening.

A religious mystic would accept this as evidence of the return of Dr. Mast's spirit to his old student; and such a thing may be

possible. Both as a scientist and as one interested in all phase of religion, I am frank to say that I do not know the answer. But I will say that there are still many things in our world that none of us understand either from a scientific or religious viewpoint.

A VIEWPOINT ON THE NATURE OF LIFE: An Examination of a Venerable Problem¹

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We are seldom in doubt whether an object before us is alive. Plants and animals are apparently quite distinct from non-living systems, such as an atom, a brick wall, a thundershower, or a few quintillion cubic miles of space that perhaps contain a star. It seems worthwhile, as a part of our continued search for explanations, reasons, correlations, to consider whether this distinction is no more than apparent or whether there is actually some consistent basis for it in the natural order.

Life is often thought of as something basically distinct from the material composing living organisms — some sort of force present in them that provides them with a significant uniqueness. It is often conceived of as being somehow conscious, embodying purpose, and modifying physico-chemical relations as they are found outside living systems. This force has been given numerous names, e.g. entelechy, élan vital, cellular consciousness (2).

I know of no method by which this animistic conception could be disproved, no matter what the situation is in reality, and therefore no method of testing it. "As Huxley has remarked, . . . ascribing (life) to an élan vital no more explained it than would ascribing its motion to an élan locomotif explain the operation of a steam engine."

(3) It is an analogy from subjective experience inserted into gaps in our knowledge, "at best making ignorance poetic."

(4) But this is not to deny the dualistic standpoint consideration as a real alternative, because conceivably there could be no adequate explanation that is objectively determinable.

Its claim to validity seems to rest ultimately on the existence of otherwise unexplained aspects of life. "Since the events are mysterious, their causes must be even more so." (5) There are many such unexplained aspects, as there have always been, such as the nature of consciousness, the origin of life, the process by which the

code embedded in the chemical structure of genes is sometimes transferred to affect the actions of the rest of the cell (and sometimes not). There have been a number of naturalistic-mechanistic (6) theories to explain (i.e. predict from generalizations and specific data) each of these, particularly the second, and many things about them are now known, but I know of no theory that adequately accounts for all aspects of any of them.

There are many such subjects that at present are not entirely explained on naturalistic-mechanistic grounds. There are also numerous ones that, altho once in this category and used as evidence for a dualistic or vitalistic attitude, can now be considered adequately accounted for. Here may be mentioned, e.g., the common phenomena of directed trends and apparent purposefulness in organic evolution (by natural selection and other factors); "equifinality," the fact that living systems sometimes arrive at nearly identical results although starting from different conditions, e.g. entire and typical sea urchins and amphibians from an entire fertilized egg, half of one, or two fused ones (a possibility characteristic of thermodynamically open systems: see later in article [7]); the apparent restriction of the formation of organic compounds to the metabolic systems of organisms (they are now widely produced artificially).

Thus, as the frontiers of knowledge are expanded, less remains of the area for which an entelechy may be offered for explanation. There are no signs of decrease in the rate of this expansion. Thus, since there also appears to be no fundamental difference in content between unexplained areas and those already accounted for, there is equally no reason to assume an explanation different in quality from those already demonstrated. We do not need to postulate an entelechy.

Life is not, of course, a quality character-

istic of all matter, as are gravitational influences and heat. It is restricted to matter of an apparently unique organization with some peculiar (in terms of non-living systems) properties. It may, indeed, be defined in a roundabout fashion as whatever it is that distinguishes a living system (naturally occurring organisms, tissue cultures, etc.) from a non-living one, a living system then being defined as one possessing certain characteristic attributes.

The following is a partial list of the qualities, aside from entelechy and similar forces, which have been stated in the last 35 years by various biologists to be characteristic of, and in general restricted to, living organisms. At least the first seven of them have been claimed (by different authors, of course) to be the only such qualities.

1. The presence of proteins (and of nucleic acids).

2. Reproduction, the offspring having a largely controlled similarity to their parents (or parent).

3. The presence of protoplasm and cellular organization.

4. The synthesis of optically asymmetric organic compounds (those rotating plane-polarized light into a different plane, which implies a great degree of uniformity among the molecules and special conditions in their formation).

5. Enzymatically accelerated (8) metabolism, i.e. the rates of chemical reactions by which useful constituents of the system are synthesized and by which some are decomposed to provide energy, are modified by substances which themselves are not changed as a result of those reactions.

6. A constant decrease, or at least no permanent increase, in the total entropy of the system; possession of a continuously lower entropy level than that of the outside world. Entropy may be thought of as a measure of the randomness of a system, inversely related to its available energy and its orderliness. Thus a lower entropy level implies a greater degree of order. With this approach to orderliness is associated a varying approximation to a steady state, to be discussed more fully later.

7. Internal control of development, to which may be coupled self-regulation of the just-mentioned approximation to a steady state, i.e. the organism exhibits a certain amount of activity without stimulus from the outside.

8. A usually positively adaptive immediate response to stimuli; irritability and motility.

9. The capacity of producing permanent adaptive changes over a period of time in response to conditions encountered in the environment and within the organism it-

self. This is not sharply distinguishable from the two preceeding.

10. Organization at several levels of complexity.

11. Growth by intussusception, i.e. by formation and deposition of new material within the substance of the system, not by deposition on the surface in the manner of crystal growth.

I think an unqualified statement can be made that no one of these attributes, taken by itself, provides the distinction desired. For instance, number 2, reproduction (or even the potentiality for it) is obviously not essential for the existence of life at a given time, but only for its indefinite continuation. Sterilization of a sexually reproducing organism is not the same as killing it.

In addition, there apparently exist non-living systems to satisfy any of the criteria given (except number 3, protoplasm: see analysis below), altho probably none satisfy them all. Take number 4, asymmetric organic synthesis. The artificial synthesis of such compounds does not give the quality of life to the materials used in this synthesis, and number 7, self-regulation, is characteristic of automatic control: a familiar example is the heating mechanism of a house when it is controlled by a thermostat.

Now if the argument is not to be circular for number 3, the concept of protoplasm must be developed without introducing the concept of life. Protoplasm as a whole does have a few unusual properties, e.g. it does not disperse when placed in water altho more than half its mass is water. There are chemical complexes known as coacervates, tho, which act similarly, even to the extent of forming vacuoles (9). In addition, it is quite possible that protoplasm originated at a later stage of evolution than the first genes (10). For a time after permanent cessation of activity by a cell it still contains protoplasm, altho it can no longer be considered alive. The great and variable complexity of protoplasm is far from being fully understood, so we are left the alternatives of choosing some known component or action which is restricted to protoplasm or of attaching a meaning to the term which will not help us in this context. Thus we do not need to consider protoplasm here apart from the suggestions, treated separately, of its major individual peculiarities.

Further consideration of the energy relationships of a living system may give us a more adequate understanding of it. One of the great generalizations of science, the Second Law of Thermodynamics, states that in any closed system (one not receiving energy from the outside), the entropy level of the entire system constantly increases (11). However, in an open system

there may actually be a decrease of energy within the system, as the system tends to a steady state—a state of maximum power output, not of maximum entropy (12). Since living organisms, like a jet of water, a crystal growing in a supersaturated solution, or in fact the earth itself, are open systems in that they do have an outside energy supply, they can be (but are not necessarily) isolated pockets of increasing order in a universe of increasing entropy. They can continue to exist only by “extracting ‘order’ from the environment.” (13)

The steady state of an organism (or of any living system), often called its “maintenance level,” can be conceived of as the level at which it fulfills the minimum energy requirements for its continued existence in the optimum constant (or periodic) environment, neglecting the energy expended in procuring food for metabolism and in disposing of wastes. This minimum energy requirement represents the difference between the living steady state (a “dynamic equilibrium”) and a “true” equilibrium, incapable of performing work, for which no energy input is necessary for maintenance. The latter resembles in this respect a standing pond (neglecting evaporation, etc.), while the former resembles a pond with a stream flowing in at one end and out the other. When a living system reaches a “true” or static equilibrium, it is said to be dead, and it can no longer return to its steady state.

“A stimulus (whether originating externally or internally) is a displacement from the steady state, into which the organism tends to return (homeostasis); the autonomous periodic activities (heartbeat, etc., initiated within the organism) represent smaller wave-trains superimposed on the continuous flow of the steady state . . . The relatively slow changes (of) growth, development, senescence, and death . . . are an expression of the fact that an organism is not truly stationary.” (14)

This steady state is perhaps not reached by viruses. They appear to be totally inert, physiologically speaking, outside living cells. It is even quite possible that the host cell itself synthesizes new viruses, using the original invading particle as a template, a model on which to build. In other words, its presence may stimulate a certain environment to reproduce it, as is the case with some crystals. Viruses also differ from plants and animals in that they do not possess a complex or a grade of structural organization. The material composing them does not appear to have the type of colloid structure found in protoplasm (15). However, they do possess the attributes numbered 1, 2, and 6 in my list, and perhaps

also numbers 4, 5, 7, 8, 9, 10, and 11 (at least when in living cells).

If life is completely explicable in terms of naturalistic mechanisms, it is a reasonable question to ask why it cannot be artificially synthesized. Within the past year one of the simpler types of virus has finally been broken down into the two non-infectious chemical compounds of which it is composed, which were then allowed to reassemble themselves to produce infectious particles similar to the original ones (16). If viruses may be said to be “alive”, life has in fact been synthesized. However, the exact composition of the compounds is not known, so they themselves can obviously not be synthesized. What has been accomplished is the restoration of life from non-living material.

But it must be emphasized that this virus is one of the simpler ones. It consists of only a few thousand giant molecules, presumably of only two compounds, certainly of only two general types (ribonucleic acids and proteins), arranged in a fairly regular structure (which, incidentally, is also not yet completely known). Even some viruses are immensely more complex than this in both composition and arrangement, and the simplest bacterium or Amoeba-like protozoan is on a level of still greater complexity. An earthworm has millions of cells of numerous types, each perhaps at least as highly organized as an entire bacterium, arranged in tissues and organs, with a vast number of subtle interrelationships. And yet proponents of a naturalistic-mechanistic viewpoint are still criticized for not being able to duplicate a form, “let alone a man.”

This almost unimaginable complexity, therefore, precludes for the foreseeable future a general detailed explanation of all life processes in terms of organismic structure and relationships. We do know many things about them; we have indications as to the methods by which many unsolved problems may be investigated with a reasonable probability of eventual solution. Nevertheless, altho life surrounds us and is a part of us, we cannot yet say with confidence just what it is.

NOTES

1. I am grateful to Professors Ball, Harrison, Hefner, Lusby, and Spencer of Miami University for their criticisms.
2. The best presentation of the vitalist approach I have seen is H. Driesch, 1929. *The science and philosophy of the organism*. Black, London.
3. Simpson, G. G. 1949. *The meaning of evolution*, p. 271. Yale U. Press, New Haven.
4. Bradley, J. H. 1952. *Patterns of survival*, p. 3. Grune and Stratton, New York.
5. Hyndman, O. R. 1952. *The origin of life and the evolution of living things*, p. 602. Philosophical Library, New York.
6. The term “naturalistic-mechanistic” is

used broadly in this paper to refer to the theory that all biological phenomena are potentially explicable solely in terms of interactions among physical bodies of some unspecified degree of complexity. A non-teleological organismic approach, which emphasizes the relations between the major parts of the organism, is a variety of this.

7. Fuller discussion in L. von Bertalanffy, 1950. "The theory of open systems in physics and biology." *Science* 111:23-29.
8. But in some cases, the more rarely, decelerated.
9. Gortner, R. A. 1938. *Outlines of biochemistry*, pp. 249-250. Wiley, New York.
10. Muller, H. J. 1955. "Life," pp. 3. *Science* 121:1-9.
11. Among the innumerable unfounded assertions in Lecomte du Nouy's book *Human Destiny* is the statement (pp. 40-41) that living systems do not obey the Second Law of Thermodynamics because their amount of order tends to increase rather than decrease. His evidence is

quite correct: living systems do show this tendency. But he neglected to mention that the generalization referred to applies only to closed systems, while living ones obviously receive energy from the outside in the form of nutrients (and, in the case of green plants, as sunlight).

12. Odum, H. T., and R. C. Pinkerton. 1955. "Time's speed regulator: the optimum efficiency for maximum power output in physical and biological systems." *Amer. Scientist* 43:331-343.
13. Schrodinger, E. 1945. *What is Life?* p. 74. Macmillan, New York.
14. Bertalanffy, L. von. 1952. *Problems of life*, pp. 131-132. Wiley, New York. (My insertions.)
15. Rickettsiae, if considered viruses, may be an exception.
16. Fraenkel-Conrat, H., and R. C. Williams. 1955. "Reconstruction of active tobacco mosaic virus from its inactive protein and nucleic acid components." *Proc. Nat. Acad. Sci.* 41:690-698.

PALEOGENESIS vs. BIOGENESIS

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The purpose of the present discussion is not so much to analyze suspected cases of recapitulation among organisms as it is to inspect the theory itself. Such a discussion may be justified by the belief that it may improve communication and increase awareness of the variations that do exist among us in connotation of the terms utilized in connection with the biogenetic law. Standardization of connotation is highly desirable and can be obtained most efficiently by seeking some limitation of definition which is mutually acceptable to the greatest possible number of persons who discuss the subject.

A discourse so directed may be accused of having degenerated to the level of a mere exercise in semantics. That it is a semasiological discourse should be understood at the outset by all concerned, but when, as at present, all argument, of which there is much, is derived not from the known facts or even from the interpretation thereof, but rather from differences in meaning of available terms, it is time indeed for focus of attention upon what would otherwise be a merely academic matter. The semantics of the present situation can no longer be regarded as purely academic.

I. The Problem

As originally conceived by Haeckel, the biogenetic law asserts that successive developmental stages in any individual will duplicate the successive adult states of its ancestors, thus compressing a whole racial

history (as seen in adult stages) into a single lifetime.

The biogenetic law, as generally stated in these words — "ontogeny recapitulates phylogeny" — is an admittedly brilliant aphorism. The more brilliant an aphorism is the more dangerous it becomes. In the present instance it is dangerous first because it is a source of error in itself, expressing as it does whole volumes in but a few words. The concept of content of those volumes is unavoidably different for different persons. Secondly, it is dangerous because it is easy to learn, is catchy, and is thus hard to eradicate or modify. Thirdly, it is dangerous because it provides a seeming panacea for a certain area of evolutionary thought. It is universally characteristic of all of us that we seek the simple explanation (at different levels for different people), whereas almost always complex phenomena have equally complex explanations. Certainly the various relations of ontogeny and phylogeny are complex.

II. Sources of Error and Misunderstanding

1. The expression "biogenetic law" is irrevocably linked in synonymy with the expression "ontogeny recapitulates phylogeny". Connotations of both have diverged from the original meanings, and if a renewed imposition of restriction on meaning is to be put into effect, the only safe restriction is to the original meaning. The original meaning is now known to be wrong. Certainly "it would be nice" to associate the term "biogenesis" with what is

now known to be the proper concept, but a bad association in meaning almost of necessity eliminates a word from a "proper" association. As noted by Simpson, a sort of Gresham's law of words operates to leave words stuck eventually with the least desirable meaning. A fortunate exception to this general "law" is the term "evolution", whose connotation has changed enormously since Cuvier's time, yet the term is still wholly acceptable with its new implications. Unfortunately the disrepute into which the term biogenesis has fallen seemingly cannot now either be denied or altered. Fortunately we do have a good alternative name — paleogenesis. Whatever the name, it should be associated with an observable relationship (as is "evolution") not with the mechanics of that relationship.

2. The word "law" is most inappropriate in application to any hypothetical biological relationship. There is no "law" that organisms must recapitulate anything, even in the broadest sense of the word that they do not *have* to recapitulate but that they simply *do* recapitulate. Many exceptions to the supposed recapitulatory rule are known. The actual recapitulation itself is *one* thing, occurring to varying degrees in different organisms; the *tendency* for organisms to recapitulate is quite another thing, and this can be envisioned as always valid. This is the generality, the "law", if you will, but a statement of tendency is scarcely a reasonable thing to be called a "law".

3. The meaning of the term "phylogeny" in the expression "ontogeny recapitulates phylogeny" is the source of the greatest divergence of inference of meaning that is involved in the biogenetic controversy. The meaning of the words "ontogeny" and "recapitulation" is stable enough, but "phylogeny" is not at all consistently defined among biologists except for the minimal agreement that it means "race history". Most biologists (e. g. Romer) interpret "race history" as the "... successive ... adult stages of ancestral types." A more reasonable stand is taken by Simpson: "The history of life as it has existed in nature is a vast succession of ontogenies of organisms, all the ontogenies being connected by the fact that each arises from one or from two others. . . . The continuum of ontogenies is phylogeny . . . (and) . . . the pattern of phylogeny brings together everything in the complex, integrated phenomenon of evolution." Had "phylogeny" been thus defined originally, or had that connotation become commonly accepted subsequently, much semasiological disputation in recent years could have been avoided, for arguments about the biogenetic law hinge chiefly upon the implication of "phylogeny". Despite complete agreement on my

own part with Simpson's view of the proper modern usage for the term "phylogeny" (which in turn is consistent with the "new" systematics and evolution), it is necessary for purposes of the present discussion to adhere to the time-honored implication of a succession of adult stages of ancestral types.

III. The Role of the Biogenetic Law in Fostering Error

In accordance with the dictates of the biogenetic law, many students have based phylogenetic concepts upon embryonic evidence that has been swallowed hook, line and sinker as an adequate basis for those concepts, even discounting other sorts of evidence in reality of much greater validity. This is true from the lowest level of anatomical detail to the highest level of phyletic relations. Actually, the comparison of non-correspondent stages of two species is obviously and absolutely wrong in principle; an embryonic stage is simply not the same as either an ancestral or descendent adult stage. Yet many ideas of phylogenetic patterns have been based upon this belief, and are even yet firmly entrenched. Certainly, if no other indication of phylogenetic pattern is available, that afforded by ontogeny can provide a working hypothesis, but it can never be more than that; it is not proof by any stretch of the imagination. Furthermore, hypothesized patterns of phylogeny that are contradicted by ontogenetic evidence are not by any means necessarily suspect. As Garstang has stated, "Morphology will never recover exactitude of outlook until it is entirely freed from the hypnotic influence of Haeckel's terminology."

IV. The Facts

It is a simple, easily observed fact that there is some sort of repetition, or recapitulation of ontogenies, not of phylogenies. The expurgated biogenetic law, which now must be called something else, is "the inherent tendency of descendent ontogenies to recapitulate ancestral ontogenies." This is what Garstang (1922) called *paleogenesis*, and this is the term that in my opinion can most reasonably be associated with the modern concept of the outmoded biogenetic law.

V. Other Possible Terms

1. The paleogenetic principle bears a close resemblance to von Baer's 4th law, to wit that "an embryo is not like the adult of a lower form, but only like its embryo." The weaknesses on von Baer's 4th law, in the present connection, are its categorical phraseology and its original limitation to

parallelism. Von Baer himself granted his 4th law no evolutionary (i. e., recapitulative) implications, but regarded it as an expression purely of parallelism. Even were evolutionary implications granted, it is wrong in its categorical phraseology, for not all ontogenies recapitulate even a part of ancestral ontogenies, and not all ancestral ontogenies are recapitulated in any ontogeny.

Even as the weakness of von Baer's 4th law is its categorical expression, so the strength of the paleogenetic principle lies in its generality of expression. Recapitulation is clearly implied not to occur regularly, or to any given extent where it is evident; there is merely a **tendency** for developmental patterns to remain stabilized in successive ontogenies. The earlier the stage the greater the tendency becomes — that is to say, the earlier the stage the rarer the deviation from the ancestral sequences.

2. The term "phylembryogenesis" of Swertsoff has a meaning closely allied to that of paleogenesis, but it is consistently accepted as something different — to wit, simply the relation of ontogeny and phylogeny. Paleogenesis best expresses that relationship.

VI. Validity of the Paleogenetic Hypothesis

The validity of the principle of paleogenesis may be induced from three natural and well-established laws.

1. Law of inevitability of evolutionary change. Certainly the rate of evolution of organisms varies greatly in different kinds and at different times, but as surely as the environment itself changes the organisms change, for the organisms are, in a manner of speaking, functions of the environment.

2. Law of stage stability. The earlier the developmental stage at which a mutation is expressed, the less is the probability (in a seemingly exponential rather than straight-line relationship) of the success of that mutation. The earlier that mutation becomes effective in ontogeny, the greater is the number of developmental sequences altered directly or indirectly by that mutation, and therefore the greater the chance that one or more of the alterations may prove deleterious. There is nothing obscure in this relationship, which is strictly a matter of probability or of chance that overwhelmingly favors late ontogenetic rather early ontogenetic changes.

3. Law of hypermorphosis. If changes are inevitable, and if they must, on the basis of sheer probability, be effected more frequently toward terminal than toward initial ontogenetic stages, they must necessarily be additive in total effect, with the developmental period tending to become progressively longer. This is referred to as

hypermorphosis, a term that has come dangerously near to falling into disrepute through interpretation as meaning solely the accumulation of successive terminal additions. Certainly a strictly terminal addition must be a rare phenomenon, but an **additive effect** does not require solely or even any strictly terminal accumulation. In this sense hypermorphosis can scarcely be regarded as of unusual occurrence.

These three laws lead inevitably to the conclusion that some sort of recapitulative effect is to be expected in every ontogeny, although by chance all degrees of deviation, from major to minor, are also to be expected. Paleogenesis may accordingly be regarded as a principle of fundamental significance in evolution at least of multicellular organisms—a principle that in its broad scope provides both for overt conformity in the form of actual recapitulation, and for apparent exceptions that in reality are an expected concomitant aspect.

VII. Adaptive Responses

The hypermorphotic aspect of paleogenesis poses a severe problem for all organisms, for developmental periods cannot increase in length indefinitely. Three sorts of adjustment are conceivable: (1) **acceleration** (or tachygenesis), wherein the rate of development may be stepped up, in effect telescoping or compressing developmental stages; (2) **abbreviation**, wherein the length of the developmental period may be reduced by appearance of developmental shortcuts; and (3) **toleration**, wherein the necessary provisions are made for the actual increase in developmental longevity.

Acceleration is seemingly not feasible within the limitations of living matter; certainly it is not commonly evident. No doubt physiological sequences such as are involved in embryonic development can actually be speeded but little if any except by temperature manipulation, although the genesis of enzyme catalyzers presumably must have contributed to acceleration in some instances. Most if not all apparent cases of acceleration are probably simulated by subtle abbreviations.

Abbreviation and toleration, on the contrary, are very familiar adjustments. Abbreviations may be regarded in a gross way as being either **caenomorph** or **paedomorph**. Caenomorphosis is abbreviation in embryonic stages; paedomorphosis is abbreviation in epembryonic stages, resulting in the appearance in adults of what were formerly juvenile characters. Paedomorphosis may be effected either by acceleration of sexual development (**paedogenesis**), or by retardation of non-sexual development (**neoteny**). Examples of both caenomorphosis and paedomorphosis are legion

and need not be cited here.

Toleration has been effected in vertebrates by three different means: (a) increase in amount of yolk (from alecithal to polylecithal extremes); (b) viviparity; and (c) parental care. Increased reliance upon each of these modes of toleration has in turn required a whole series of adaptive modifications such as the shift in disposition of yolk (from homolecithal to telolecithal types), alteration in cleavage (from holoblastic equal to meroblastic), perfection of the placenta with loss of egg yolk, and so on.

Adjustments by way of abbreviation and also by toleration obviously have occurred indiscriminately among organisms, some showing a preponderance of adjustment by one means, some by others. By their circumventive nature these adjustments all testify to the fundamental, underlying importance of the paleogenetic principle — that descendent ontogenies tend to recapitulate ancestral ontogenies.

VIII. Haeckel in Perspective

It is apparent that Haeckel indeed did not clearly understand the nature of the phenomenon he interpreted as the biogenet-

was not the first to have perceived the presence of some fundamental relationship, however, for even as early a student as Aristotle knew something was there. Many assayed its truly grand proportions. He did law, but he does seem correctly to have others have contributed importantly to an understanding of phylembryogenesis; among them Kiemeyer (1793), Meckel (1811), Serres (1824, 1842, 1859), von Baer (1828), Chambers (1844), Darwin (1859), Muller (1864), Garstang (1922), Hadzi (1923 et. seq.), Sewertzoff (1927), Meyer (1935), George (1933), Emerson (1949), Hyman (1940), de Beer (1951), Simpson (1953), and Hardy (1954) deserve special mention. Of all these, the pioneers who are the most deserving of credit for having the mental stature enabling them to reach the farthest (in this connection) beyond the confines of their own intellectual climate are Aristotle, Garstang and Hadzi. It is then quite proper that the undue credit formerly assigned to Haeckel for his biogenetic law be rectified by general recognition of the refined product of a mind proved to be a giant in its time by attaining real mastery of this complex relationship. Garstang's paleogenesis is a fitting successor to Haeckel's biogenetic law.

OBSERVATIONS ON THE BEHAVIOR OF A MINK

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Presented before the Ohio Academy of Science, May 2, 1947

For most of the past twenty-six years I have maintained a wildlife sanctuary as an adjunct to our Biological activities at Miami University. The 14-acre tract is composed of timbered hillsides and ravines, a small stream, and for some time included about an acre of impounded water.

On this pond semi-domesticated mallard ducks were kept as decoys for the attraction of migratory wild-fowl and as many as nine species have appeared on the pond in a single spring migration season.

The presence of these ducks and other forms of wildlife served to attract predator mammals to our area; foxes, skunks, raccoons, opossums, minks and weasels being regular visitors, not to mention a high quota of cats and dogs.

The varied habits of these predators offered their share of behavior problems to the list of our observations within the sanctuary. The mink which serves as the subject of this report is but one of several of our musteline visitors. The behaviors

reported here are not entered in any contest over the controversy as to whether animals think or exhibit activities that precludes a rational choice of behaviors. These observations were made by two biologists (who were both sober at the time) and their findings were shared by three alert school boys of "scot" ages.

Five mallard ducks (two males and three females) remained on the pond as it froze over in early January. A small oval area was kept free from ice for several days by the swimming activities of these ducks, but this, too, was finally frozen over. A feeding trip to the pond on the morning of January 6 showed only three mallards — two males and one female, near the site of the former swimming hole. In the weeds above this area lay the body of another duck, but one of the females from our flock was missing. Tracks in the snow showed the destructive predator to be a large mink. The dead duck showed wounds where sharp teeth had pierced the region

of the junction of the neck with the head.

After noting the course where the missing duck had been pulled through the snow, I carried the frozen body of the dead bird to the house, assembled our tracking crew, and together we followed the trail of the mink and his dragging burden.

From the frozen-over water area the bird had been pulled across the ice to a brush pile in the opposite corner of the pond, a distance of about a hundred and twenty feet. Here the mink left his burden and loped over the bank of the pond, across the garden, in and out of a ground hog burrow, and into a neighboring cornfield. Returning along the creek the mink passed under the fence, over the bank of the pond and again dragged the duck across the ice, up the bank opposite the site of his kill, along the top of the bank, down the steps by the dam, through the fence, and into the small stream below the dam. Here the bird was dragged up a steep stone wall for a distance of four or five feet and again abandoned in the snow while the mink made an exploring expedition of more than 100 yards to the top of high clay bluffs that rise 58 feet above the under-cutting stream. On his return from the bluffs the mink carried the duck back down the stone wall, down the small stream to the main creek, across the ice, up the bank and along the run for a distance of a hundred yards. Here the beast and his burden entered a mass of loosely piled logs, passed out the opposite end and into a weed-grown field where close standing stalks of goldenrods and asters certainly must have hampered progress. After passing through this field

the course led to a high bank above the stream. Here the duck was again laid on the snow while the mink made an exploring expedition of about one hundred yards upstream and, coming back to the booty, carried the carcass down a steep, fifteen foot bank, across the stream and along the border for three hundred yards, passed under a swaying floodgate and returned to the ice of the stream to enter an arching culvert where the run passes under a railway embankment. Beyond the railway the mink laid his burden on the ice, explored upstream for some distance and, returning, dragged the duck into a pile of huge blocks of limestone dumped at random against the culvert to prevent water cutting. Here we found the body of the duck cleverly concealed beneath a great slab of limestone weighing more than a thousand pounds. The carcass was less than three feet from the edge of the rock heap but had been dragged over an irregular course beneath the rocks for more than six feet. We could have drawn the bird out of this place but decided to allow the captor to retain his spoil after so much labor and such clever manipulation in moving a burden, that must have exceeded his own weight by a least fifty percent, for a distance of nearly half a mile.

The directness of the course followed by this mink and the side excursions without his burden suggest the deliberations of an engineer with an exacting moving job on his hands. If a mink does not think, he gives a better imitation of thoughtful action than that exhibited in some human activities.

PHILOSOPHY OF GRADUATE DEGREES

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Research is concerned with inquiry and requires the use of knowledge in the process of developing, finding or creating more, which usually manifests itself in the scientific field in the firm of new facts, principles or theories. Pursuit of knowledge involves research which is an art that can be improved and augmented with increased experience of the worker. Research experience of an individual is usually initiated in connection with graduate degrees.

What the undergraduate learns about research and its methods is not acquired formally. In advanced courses in an average college undergraduate curriculum scientific research and its methods are mentioned or

alluded to sufficiently, so that most students have a passive appreciation of these phenomena. They have an awareness of a function of mind that they have not been in the habit of using consciously and some acquire a fascination for it and a desire to use it. This, then, is the developmental process which underlies basically the development of a graduate student in research.

The transition from the passive, informal to the active, formal state is sometimes a trying experience for the student, as well as the teacher who sees in the student the faculties that indicate research potentials.

It is felt that the function of the Master of Science degree is crucial for the purpose

of making this transition. If the student is successful he develops potential and can pursue the degree of Doctor of Philosophy with a greater degree of confidence and less lost effort in his accomplishments.

This degree, Master of Science, then is regarded as an apprenticeship or buffer enterprise during which time the student must become acquainted with many associated activities well nigh simultaneously. The period of the Master of Science degree candidacy gives the student time to acquire, handle and organize data. He has an opportunity to test his ability in critical reading, expression in writing and in the evaluation of literature. He is required to coordinate his own work with the past and to make a final appraisal with reference to the past or what was known formerly and project the field of newly created problems. He learns what research entails in a formal procedure.

The teacher on the other hand has the opportunity to observe academic, scientific and personal behaviorisms. It gives him an opportunity to advise when critical decisions are in the making and to give advice

as to the research best fitted to the candidate as a life work. In doing this he will have determined the aptitudes including initiative, desires, abilities, capacities and stabilities in disappointments and mental conflicts in order to arrive at a final appraisal of the candidate as a future scientist.

It is my opinion that the candidate for the degree of Doctor of Philosophy is a molded individual who has an appreciation and working knowledge of the scientific method and who has most of his basic informational subjects and training preparation behind him. It is felt that he should be capable of determining and acquiring the supplemental informational subjects that are necessary. He should be given academic freedom in the realm of his research and in the preparation of his thesis. He should be made to shoulder the responsibility of producing and made to justify his acts and procedures from the scientific approach. He should be queried and advised when necessary, but encouraged to do everything himself in connection with the gathering and processing of data and in the final preparation of an acceptable thesis.

THE ORIGIN AND EVOLUTION OF THE HONEY BEE

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Part I—Solitary Wasps and Their Ancestry

In seeking the pattern of the origin and evolution of the honey bee, we glimpse the age long chain of events which has produced that marvelous insect society that the beekeeper manipulates so skillfully for the advantage and enjoyment of everyone.

Nearly everyone has heard of evolution. Within the past hundred years the sciences of biology and geology have established the fact of evolution beyond the line of reasonable doubt. The living inhabitants of our planet earth have not always been as they are today. Ten million years ago, in all probability, man had not appeared. Seventy million years ago the present race of warm blooded mammals was replaced, for the most part, by the giant reptiles. Go back another hundred million years and the flowering plants had not yet come into being. Another hundred million years, and the reptiles had not yet evolved from the amphibious salamanders; and a few hundred million years more and the continents were standing bleak and bare, uncovered by any plants more luxuriant than a few mosses and uninhabited by air breathing animals of

any sort. This is the picture evolution draws.

But even at this early epoch the seas were swarming with living things. Every living thing is adapted to the conditions under which it lives—otherwise it would have been killed off long ago or never have come into existence in the first place! Moreover, living matter — bees, humans, plants — is eternally restless, forever reaching out for food materials that it may grow and produce more living matter like itself. The process whereby living matter reproduces itself is a very complicated one — so complicated that it repeatedly does not "make the grade," does not reproduce a new individual exactly like the old, but instead gives rise to a slightly different kind of organism. Part of the time, the new sort of individual is unable to get along so it dies. Part of the time, it barely survives. But once in a while the new type is successful in an important way. In fact, it may be so successful that it may drive out the parent type that produced it. This is evolution. And this is the process that, repeated over and over again millions of

times in the course of earth history, has produced the multitude of organisms as we know them.

Three types of living things dominate the life of the land. First there are vascular plants, by which we mean plants with roots for extracting water and foods from the soil, stems for support, and leaves for absorbing the energy of sunlight. Vascular plants furnish the food supply on which the land animals live. Land animals themselves are of two principal types—the insects and the vertebrates. These two types approximately divide the land between them. Both feed on the plants and on each other. In size the insects and their allies leave off just about where the vertebrates begin. The insects with their exoskeletons and breathing tubes penetrating into all parts of the body are adapted for life in the small. The vertebrates with their endoskeleton and the rushing torrent that is their blood stream are adapted for life in the large.

The first insects were slow flying dragonfly-like creatures four or five inches across the wings. They developed way back some 240 million years ago at a time when the most highly developed vertebrate was no more than a very primitive reptile. They were the first animal ever to develop wings, but through just what stages they went to get their wings the rocks have not so far revealed. The possession of wings opened up great vistas to the insects, however, and the dominant position they have ever since occupied in the economy of terrestrial animals is undoubtedly due to them. Getting into the air played the same role in the Paleozoic that it plays in modern war. Command of the air leads to success, whether it be evolutionary or military.

The particular group of insects to which the bee belongs is known to entomologists as the Hymenoptera. The name Hymenoptera is derived from two Greek words: *hymen*, membrane, and *ptera*, wings; and Hymenoptera possess membranous wings. But so many other insects have membranous wings likewise that the characteristic has very little of what the entomologist speaks of as diagnostic value. Three things among others had to happen to the original dragonfly-like insect I have just been telling you about before it evolved into the Hymenoptera.

First and in common with the great majority of other insects it had to form the habit of folding its wings flat over its back when they were not in use. Every beekeeper has observed this habit in his honey bees. Nothing is more useful than wings when one wants to fly, but nothing is more useless than those same wings when one wants to walk around. An airplane in street traf-

fic will convey my meaning. *

The second specialized feature of the Hymenoptera is likewise a characteristic that they share with many other insects. I refer to the differentiation of the life cycle into a wingless grub-like larval stage and a winged adult. The growing stages of the first winged insects developed their wings as useless stumps extending out at right angles from the sides of the body. It was a great evolutionary advance when these wing-stumps or wing-buds were first laid back over the body while they were developing and then were developed internally and completely out of the way until just before they were ready to be used by the animal.

The result of this particular bit of evolution was to make the young insect or larva a very different sort of an animal from the adult. This structural difference has been frequently seized upon by natural selection—to use figurative language—to adapt the larva to a mode of life quite unlike that of the adult. And we have a good deal to say about the evolution of larval habits as our account of the honey bee's evolution proceeds.

The third specialized peculiarity of the Hymenoptera is one that is possessed exclusively by it and returns us to a further consideration of their wings. The original dragonfly-like insect had two pairs of wings of nearly equal size, and each quite separate from the other. In the Hymenoptera the hind wings became reduced in size and joined to the front wings by a series of minute hooks along the front margin of the hind wing. In this way the two wings on either side came to function as a single unit, and one must look closely at a bee to realize that it has more than a single pair of wings. On the side we may well wonder at the caprice of nature that started out by evolving two pairs of wings and then insisted on uniting them into what is functionally a single pair.

An observation is in order at this point. The primitive dragonfly-like insects I have mentioned are actually known from imprints in the rocks of the Pennsylvanian period, some 240 million years ago. Entomologists refer to them as *Palaeodictyoptera*—ancient net wings, and they were so primitive that they eventually became extinct. Fossilized hymenopterous insects are first known from the Triassic period, about 175 million years ago. But virtually all the details I shall relate of the gradual development of a generalized hymenopterous insect into the specialized honey bee are derived from a comparative study of various living types of Hymenoptera. Nor do I profess more than the very slightest originality

or most of my statements. Practically all my facts and a large segment of my theory is derived from that very great student of social insects, the late William Morton Wheeler of Harvard University. Professor Wheeler was the author of two fine books, *Social Life Among Insects* (1923), and *The Social Insects* (1928), and most of what I have to say forthwith is taken from them. Not very much in either of these books is directly concerned with the honey bee. Professor Wheeler's specialty was ants. But if any one is interested in the general biological setting out of which the honey bee has emerged, I can suggest no more pertinent or entertaining reading than that provided by these two books by Wheeler.

The first Hymenoptera, back at the beginning of the Age of Reptiles, some 175 million years ago, probably were insects somewhat resembling the sawflies. These creatures have larvae which feed on the leaves of trees after the fashion of caterpillars. The adults are short-lived winged insects that feed on leaves and that lack the thread-waisted structure of the higher Hymenoptera. Such were the remote hymenopterous ancestors of the honey bee.

An early step forward in honey bee evolution is represented by the ichneumon fly or one of its relatives. The larvae of these insects have given up the vegetarianism of the sawflies and have come to live in other insects. In response to these conditions, the larvae became blind legless maggots—since nature very frequently does not allow organisms to retain structures for which they have no further use. They feed as parasites among the internal tissues of the host insect, which usually dies about the time that the larvae mature and transform into winged adults.

The more primitive of these parasitic Hymenoptera deposit their eggs on plants. These emerge as active larvae which transfer themselves to an appropriate passing insect and burrow in. This habit, however, results in a great wastage of larvae which are unable to find a proper host, so that most of the parasitic Hymenoptera deposit their eggs directly on or under the skin of the host by means of the ovipositor. And it is the ovipositor sharpened for depositing eggs under the cuticle of the host insect that is the direct ancestor of the sting of the wasp and the bee.

The next step in the evolution of the honey bee was the transition from the ichneumon fly to the wasp stage. This occurred when the host insect ceased to walk around and feed while harboring the hymenopterous larva, but instead was immobilized by poison injected by the insect's ovipositor, which now may begin to be called a sting.

Wheeler (*Social Insects* p. 61-64) describes how a minute wasp named *Scleroderma* about a tenth of an inch long will attack the larva of a wood boring beetle many times her own bulk. She stings the beetle larva repeatedly, but she is so minute that it takes from one to four days for her to inject enough venom into her prey to quiet it. Meantime she feeds on droplets of the host's blood that exude through the punctures she has made. Her abdomen enlarges and in a few days she has laid eggs which hatch into larvae that feed through punctures that they make in the cuticle of the immobilized beetle larva.

The next step is represented by a wasp like *Bethylus*, the female of which immobilizes a caterpillar and drags it to a hollow reed. There she deposits several eggs on her victim and these emerge into larvae which develop on the food supply thus provided for them.

The more typical wasp habit is represented by the genus *Spheg*. After the female has mated, and as the first egg is approaching maturity inside her abdomen, she seeks out a suitable patch of sandy ground, constructs a burrow, and widens its end to form an elliptical chamber. Then she returns to the surface, closes the entrance, and takes off in a slow undulating spiral to fix in her "mind" the precise position of the burrow in relation to the surrounding objects. Then she flies off in search of her prey, which is a particular species of hairless caterpillar. When it is found, she stings it into insensibility, gnaws a bit at its neck and feeds on some of the exuded juice, and drags it or flies with it to the entrance of her burrow. Here she drops her victim and, after entering and inspecting her burrow, returns and takes the caterpillar down into the chamber. Now she glues a single egg to her victim's surface and closes the burrow by filling it with sand. She may even tamp down the earth with a carefully selected pebble held in her jaws. As soon as the next egg ripens in her ovaries she repeats the same cycle of behavior at another spot. The egg, of course, soon hatches and the wasp larva feeds to maturity on the immobilized caterpillar. Such is the remarkable history of the solitary wasp.

Part II—Primitive Bees

The probable stages in the evolution of the honey bee that I have been describing for you seem to have occurred in the early and middle portion of the Age of Reptiles, from 175 to 110 million years ago. The particular insects I have been telling you about are living today, but the sort of hymenopterous habits they represent probably came

into existence at this remote geological period.

About two-thirds of the way through the Mesozoic Era—this is the technical name by which geologists call the Age of Reptiles—an important event occurred in Earth history. For millions of years the Plant Kingdom had been specializing on giant horsetails, tree ferns, seedferns, and conifers. And then, all of a sudden—at least it is sudden in the perspective of the geologist—the great group of the flowering plants spread over the surface of the land. The first flora of flowering plants is known from the Lower Cretaceous of Greenland and some have suggested that it was under such relatively rigorous conditions that the superior reproductive mechanisms of the flowering plants first proved their worth. Previously the lands had been occupied by woody-stemmed trees and shrubs. Now more plastic herbs and grasses came into existence and the stage was set for further advances among the animals.

In particular, the evolutionary history we are interested in could never have been told had not this particular bit of plant evolution taken place. For, without the grasses, man, perhaps, could never have become civilized. Deprive man first of his grass foods—wheat, rice, corn, barley, oats—and of those animals that feed on grass—cattle, horses, sheep, goats—and where is he? Civilization is probably impossible. On the other hand, deprive the bee of its pollen and nectar—and bees would never have come into existence.

The transition, then, from the insect-eating solitary wasp to the pollen- and nectar-eating solitary bee was a momentous one. Certainly the protein-rich supply of food provided by the coming into being of the flowering plants could not have long remained neglected by the insects. And the wasps, who had already proved their biological ingenuity by their insect-eating ways, were the insects that provided the exploiters of this new source of food. The transition in food habits is heralded by the propensity that many wasps have for visiting flowers and feeding on their products. What happened, then, was that some unusually enterprising wasp took to feeding not only itself but its larvae on food obtained from this source.

From their wasp ancestors bees received the powerful wings, the large finely faceted eyes, and the sensitive antennae necessary for searching out the flowers in the first place. The labium has become especially elongated for lapping or sucking up the nectar from the nectaries of the flower. The anterior portion of the alimentary tract is

enlarged in the female to form a bag-like distensible crop for the transportation of the nectar back to the nest, and its walls are muscular, enabling the bee to regurgitate its contents. The regurgitated nectar is known as honey, because, during its sojourn in the crop, it has become mixed with minute quantities of an enzyme, causing its cane sugar or sucrose to become converted into levulose and dextrose.

The more primitive bees, of which *Prosopeis* may be a living example, may have transported pollen as well as honey in the crop, and may have been very wasp-like in general appearance. Eventually, however, as in the overwhelming majority of living bees, the body became thickly covered with plumed or feather-like hairs. The function of these was to rub against the stamens as the bee explored the flower and to brush off a quantity of the pollen. Later the insect, if a female, combs itself with its legs, moistens the pollen with a little honey, and attaches the resulting mass to the outer surface of the tibiae and tarsi of the hind legs. Here an arrangement of long stiff hairs forms a pollen-basket or corbicula in which the pollen is transported. The male is not concerned with feeding the larvae. He possesses plumed hairs, but has not developed the devices for transporting food.

These remarkable mechanisms in the bees have had their repercussions in the evolution of floral structures. The bees and other insects in going from one flower to another provided a method of cross fertilization that was much more efficient than cross fertilization effected by air currents. The result was that many plants under the influence of natural selection gave up effecting their reproduction by the use of air currents and have become exclusively dependent on insects. Those species of plants exhibiting the richest stores of nectar and pollen would then be most successful in their reproductive processes—and so the evolution of flowers and bees went hand in hand, to the mutual advantage of each.

And wherefore these multitudinous adaptations on the part of the bee? Primarily to supply a tiny brood chamber hidden away somewhere with enough food to accomplish the development of the larva that will emerge from the egg that will be laid therein. All of life is oriented towards its own perpetuation, and the bee is no exception.

Famous as the honey bee is for its marvelous society, ninety-five percent of the existing species of bees are solitary creatures living life-histories essentially similar to the *Sphex* wasp already described. This is in marked distinction to the wasps, where

A considerable proportion of the species are social, and especially to the ants and termites, where all the living types live in societies. The difference is that the burrows that the female bee excavates, instead of being stocked with one or several insensitized insects, are stored with pollen, and it is upon this that the legless bee grub grows to maturity. In this connection I recall a metallic blue bee about the size of a honey bee that for several years excavated its burrow in the mortar between the bricks right by my front door. First I would notice it making trips in and out, either excavating the burrow or bringing in supplies of pollen. Then, of a sudden, the burrow would be plugged with mud, and at some later date, when I wasn't looking, the young bee would emerge and the burrow await reoccupancy.

The precise transition from the solitary to the social habit is conjectural, but there are several forms that have habits that are suggestive of what it may have been. Wheeler quotes the observations of Dr. Hans Brauns on several South African species of *Allodape* (*The Social Insects*, pp. 84-89). It appears that these bees usually nest in the stems of iris, rose, *Rubus*, etc., that have been hollowed out by other bees or wasps! The female of a certain rather diminutive species of this genus, after having fixed up a hollow stem to her satisfaction, lays an egg that is about one-third as large as she is. She then proceeds to gather enough pollen to nourish the larve through to its pupation, whereupon she deposits a second egg right above the first and gathers food for it. Such habits represent the beginning of social life, because the mother remains active in the presence of the developing larvae.

A slightly more advanced stage of sub-social evolution is represented by *Allodape pringlei* Cameron. This bee attaches her eggs to the interior of the stem in perpendicular rows of as many as ten or more. After the eggs hatch, the larvae gather in clusters, and the mother nourishes them by placing food in the space between their heads where they can all feed on it together. A stage has at last been reached where the parent is tending the living larvae.

The highest development reported in *Allodape* is represented by *Allodape ceratinoides* Grib. In this type the developing larvae are kept supplied individually with pollen by the mother, and the nest in the course of time comes to be occupied by larvae and pupae in various stages of development. Eventually the pupae transform to adults who return to the parent nest for shelter, at least for a time. The young adult virgin females aid in collecting pollen

and feeding their brother- and sister- larvae, thus establishing a genuine if somewhat transitory insect society. None of these females are sterile, however, and, in all probability, after mating, fly off and found new nests. But unexpected surprises may well await further investigators of these interesting African bees.

Part III—The Higher Bees

The overwhelming majority of insect societies are characterized by the existence of sterile individuals—individuals who have lost the power of reproduction and whose sole function is to gather food for the colony and/or to participate in its protection from enemies. It is the existence of these functionally sterile individuals that distinguishes the insect society from that of man. Among the termites sterile individuals are furnished by both sexes, but among the wasps, ants, and bees, only the females lose the reproductive power. The males (called drones among the honey bees) remain relatively primitive unsocialized insects whose only function in the economy of the society is to mate and die.

The most primitive of the bee societies that are characterized by the existence of a sterile worker caste is the short-lived colony of the temperate zone bumble bees of the genus *Bombus*. As before, it is not at all certain that the honey bee ancestor went through this precise stage, though it would seem probable that the first bee societies were of a temporary nature.

In the temperate zone the only stage of the bumble bee to survive the winter is the fecundated female, who burrows into the ground sometimes in the immediate vicinity of the nest in which she was reared.* In the spring she seeks out a suitable location on or in the ground, frequently a deserted mouse nest, and there hollows out a space about one inch in diameter in which she sets up housekeeping. Her first care is to build a small mound of pollen-paste, made of pollen moistened with honey. On top of the mound she makes with her jaws a circular wall of wax, which is secreted between the segments of the abdomen. Within the cell so formed she lays from seven to sixteen eggs and seals it over. Meanwhile, in the entrance to the nest, the female constructs a waxen thimble-sized honey pot in which she stores honey to feed on in inclement weather. Immediately the eggs have been laid she sits on them and the larvae and pupae into which they develop, brooding them with her body warmth both day and night and leaving them for

* In addition to Wheeler, my account of the bumble bee derives from F. W. L. Sladen, *The Humble Bee*, London, 1912, 238 pp., illus., and O. E. Plath, *Bumblebees and Their Ways*, New York, 1934, 201 pp., illus.

brief intervals only to collect food.

After about four days the eggs hatch, the larvae feeding at first on the mound of pollen and also on fresh pollen that the queen collects. The queen also feeds the larvae directly on a regurgitated mixture of pollen and honey, making a small hole in the larval cell for the purpose. About seven days after hatching each larva, if properly fed, produces a thin and papery but tough cocoon, and eleven or twelve days later—twenty-two or twenty-three days after oviposition—adult bees emerge. These first bees are undersized sterile females or workers and immediately set about collecting food and caring for their sister-larvae, some of whom have emerged from eggs laid when the first batch of larvae were changing into pupae.

It has been conjectured that the sterile worker caste first arose in the bees because of inadequate diet, the single founding queen being unable to collect enough food for her progeny, and that only later in the season as more food-gatherers are produced are the larvae sufficiently nourished to become functional females and males. At any rate such is roughly the case in the bumble bee.

As the season advances the nest enlarges, brood cells and honey pots increase in numbers, and the whole becomes encased in a waxen wall. The population increases to from 50 to 500 individuals, varying in different species and under different conditions. Unfertilized worker-laid eggs are said to develop into males, anticipatory of the parthenogenetically produced males in the honey bee. Sladen (p. 49) says that both females and males are produced by queen-laid eggs, but whether such males come from unfertilized eggs is not indicated. At any rate, almost as soon as the males and functional females emerge they leave the parent nest, mate, and the females prepare for the winter. The aged queen and her little band of worn-out workers now sit together on top of the deserted comb, making no attempt to rear any more brood. "One night, a little cooler than usual, finding her food supply exhausted, the queen grows torpid, as she has done many a time before in the early part of her career—but, on this occasion, her lifework finished, there is no awakening." (Sladen pp. 54-55).

The bumble bee's history thus suggests how a worker caste may have originated, and shows us a diminutive hymenopterous society in which the workers eventually take over the maintenance of the colony. In still another respect the bumble bee illustrates an important feature of insect life, namely the invasion of the nest by other species of arthropods. Some of these are purely scavengers in the nest, doing the

bees no harm, like the bumble-bee mimicking fly *Volucella*, the beetle *Antherophagus*, the mite *Parasitus bombarum*, and others. In Europe however, the wax moth *Aphomia sociella* is very destructive. The full grown caterpillars are an inch or more in length. They feed on the brood, and a hundred or more of them will completely riddle a large comb with their silk-lined tunnels in a few days. As interesting as any of the invaders of the bumble bee nest is the parasitic bumble bee *Psithicus*. These bees lack both the food-collecting instincts and the food-carrying structures of the true bumble bees. The fecundated female enters a well-established bumble bee nest, kills the queen and lays its own eggs which are reared by the host workers. These social parasites have no worker caste. They closely resemble true bumble bees and are believed to be evolved directly from them.

The persistently primitive feature of the temperate zone bumble bee society is founded in the temporary character of the social unit and the fact that it is established *anovo* each spring by the unassisted efforts of a single fecundated female. The relative inefficiency of this method of society formation is shown by the heavy mortality that Sladen noted among newly established bumble bee colonies.

A beginning at more effective colony formation is perhaps represented by certain South American bumble bees where, according to Wheeler who quotes H. von Thiering, the colonies are perennial and new colonies are established by the swarming of groups of daughter queens and workers. Further information on these interesting bees would be in order.

More is known about the tropical Meliponine bees.* These are known as the stingless bees, from the abortion of their stinging and poison sacs to the point where they are no longer functional. These bees usually live in colonies in hollow tree trunks or other deserted places, sometimes in deserted ant nests underground. Some of the species are much smaller than honey bees and their societies range in size from a few dozen individuals to as many as 80,000 (as many as in the honey bee colony). The worker caste, as with the honey bees, has taken over the work of the colony. The younger workers produce the wax, and the older workers forage for food. They differ from honey bees in building the comb in horizontal rather than vertical layers, and in storing the honey and pollen in large honey-pots, and they differ from both bumble bees and honey bees in completely stocking the brood cells with food before closing them, so that there is no feeding of

* Schwarz, Bull. Amer. Mus. Nat. Hist. 90, 1948: 1-166.

the developing larvae by the adults. The functional females exhibit specialization for reproduction and certain signs of degeneration. Her pollen carrying structures have disappeared and her head is smaller. Her abdomen becomes so swollen with ovaries that eventually she becomes unable to fly. There is only one mother queen in a colony, but a number of virgin daughter queens are tolerated, and there is some evidence* that, unless fecundated, they die off or are killed by the workers within 15 days in certain species. On the death of the mother queen, a daughter queen may take her place, and new colonies are formed by the swarming of a single young queen accompanied by a detachment of workers. One suspects that an unassisted Meliponine female is unable to start a new colony.

In the more primitive stingless bees, like *Trigona* and *Lestrimelitta*, functional females develop in larger cells as the result of special feeding. In *Melipona*,* however, queens and workers receive similar food and develop in identical cells, and there is evidence that queens develop as a result of the proper assortment of genes in the egg, so that in some species one-fourth, in other species one-eighth of all females produced are regularly queens. The workers then kill off the surplus queens, as already noted.

The nests of stingless bees are inhabited by a series of other arthropods, many of which live only in such situations, and about a third of which are beetles.* Most of the inquilines of stingless bees appear to be scavengers, and some of the beetles (e.g., *Scotocryptus*, *Cleidostethus*) are blind, with the head, antennae and legs folded beneath and completely hidden by the pronotum and elytra, so that the insect presents merely a smooth, hard, hemispherical surface which is very difficult for the bee to grasp. The details of the biology of these inquilines are still largely unknown.

Wild honey gathered from stingless bees has served man as a luxury or, sometimes, even as a regular article of diet in both the Old World and the New. In Mexico and Central America, and even in parts of South America, several species have been domesticated since the pre-Columbian era. The principal domesticated species is *Melipona beecheii* Bennett. The hives are usually short sections of hollowtree trunks plugged at the ends with a hole bored in the side for the use of the bees. Especially in Yucatan, hives of this sort are frequently stacked up like cord wood in appropriate shelters, and single apiaries consisting of

as many as 600 or 700 hives have been reported (Schwarz, p. 147). As much as three gallons of honey has been reported as having been produced annually by fairly large artificial hives, and both honey and wax from the stingless bees were extensively used in Mexico at the time of the Spanish conquest. With the introduction of the more pugnacious, and probably more productive, honey bees, the cultivation of stingless bees has tended to fall off, but is still widely practiced.

In treating *Allodape* and *Bombus* and the Meliponines, I have not intended to suggest that they represent actual stages through which the honey bee ancestors passed. Certainly, once having achieved progressive provisioning of the blood cells, as in *Bombus*, it is quite unlikely that mass provisioning of the cells, as in the Meliponines, was ever resorted to. And the inability to fly of the old Meliponine queen, and the substitution of a genetic basis for the differential feeding mechanism of worker-queen determination, are specializations that go beyond anything in the honey bee. At most, then, the economy of these "lower" bees is but a suggestion of the sorts of biological situations out of which honey bees may have come.

From the meliponines it is but a step to *Apis*, one of whose species is *Apis mellifica*, the honey bee. If the functional females in this genus are less specialized than the meliponines in never losing the ability to fly, they are on a par with them in giving up pollen- and honey-collection, in possessing a smaller brain, and in being unable by themselves to establish new colonies. In one respect, however, the members of the genus *Apis* are specialized and unique, and that is in the intolerance of the female of any other female in the colony, either virgin or fecundated. This is closely tied in with the method of new colony formation, which is by the swarming of the old queen accompanied by old workers, who leave the nest in possession of young workers who release a new queen. The larvae are reared in open cells by progressive feeding by the workers. Unfertilized eggs produce males. Queen develop as the result of an exclusive diet of "royal jelly" produced by the pharyngeal glands of the worker. "Royal jelly" is especially rich in protein and is not fed to worker and drone larvae after the first days of larval life.

The genus *Apis* contains three species, the two more primitive of which occur exclusively in the Indo-malayan region, indicating this as the probable site of the origin of the group. The most primitive of these is *Apis dorsata*, the queens of which may be nearly an inch in length, the work-

* Kerr, Genetics 35, 1950: 143-152.

* Kerr, Evolution IV, 1950: 1-13.

* Salt, Trans. Ent. Soc. London 77, 1929: 431-470.

ers and drones about two-thirds as large. These bees construct enormous combs which hang more or less exposed from the branches of trees and similar situations. The comb cells are all of the same size and type and the colonies are said to be migratory, though details on this latter point are lacking in the literature. Do they, for instance, desert the developing brood at the time of migration, or is each migration preceded by a period of about three weeks in which no eggs are laid? Either habit would be most astonishing. It is claimed that the migratory habit prevents the establishment of this bee in hives (Wheeler) but this is disputed.*

Apis florea, the second Indo-malayan species, is smaller than the honey bee. It likewise constructs exposed combs, but the cells are differentiated for honey-storage, for worker-larvae, for queen-larvae, and for drone-larvae, as in the honey bee. They are said (Benton p. 13) to produce so little surplus honey as to make their domestication quite unpromising.

The honey bee, *Apis mellifica*, likewise occurs in Indomalaysia, and may be presumed to have arisen in that region. The comb cells are differentiated, as in *florea*, but in contradistinction to both that species and *dorsata*, it nests in hollow trees and other protected places. This habit, plus its ready tendency to lay up a surplus of honey, made it possible for the honey bee to migrate out of the tropics and take up its abode in the temperate zone as well. The colonies were large enough, the individual bees were large enough, the nesting sites offered sufficient protection so that the body heat of the bees would keep them through the winter. And the accumulated stores of honey provided food during the same inclement period.

So far in our discussion of the true bees little has been said about the geological background. Solitary bees in all probability did not evolve from wasp ancestors till flowering plants became plentiful in the Cretaceous period, some 100 million years ago. Bumble bees appear to be definitely known as fossils in Baltic amber (Lower Oligocene, about 30 million years ago), but there seem so be no other dependable records of fossilized social bees. Any estimate of the geological antiquity of bees with the *Apis*-type of biology would be a gratuitous guess. My own would be on the order of some millions of years, with the probability that honey bees had been operating in their present fashion for many hundreds of thousands of years before they attracted human attention.

Before making contact with man they

seem to have spread widely over Eurasia and Africa and to have broken up into a number of geographical subspecies. Thus the south Asiatic form is known as *indica* and the South African form as *kaffra* or *intermissa*, and some of the domestic races may go back to pre-human origins.

In certain aspects of their basic evolutionary pattern the honey bee shows striking similarities to that two-legged animal man with whom about ten thousand years ago they came to establish such a mutually advantageous alliance. First the honey bee, like man, has spread itself over practically the entire earth as a single species, not splitting up into diverse species as have the other social bees. Like man, the honey bee shows evidence of developing distinct local geographical races. In both honey bee and man the wide distribution appears to be the result of a highly successful social structure adaptable in detail but rigid in its essentials. Except that both involve co-operation, the precise type of society evolved in the two instances is widely different. Human society, we hope, is still capable of modification. The honey bee's society has already achieved all of which it seems capable.

The nest of the honey bee is invaded by a series of moths, the caterpillars which feed on the comb or its contents. Some of these, like the Mediterranean flour moth *Ephestia kuehniella* Zell.) and the Indian meal moth (*Plodia interpunctella* Hbn.), are stored product insects not at all confined to the bee hive. Others, like the wax moth (*Galleria mellonella* L.) are restricted to the bee hive and may do considerable harm to the colonies. The bee louse (*Braula coeca* Nitzsch) is a wingless fly that as a maggot burrows in the cappings of the honeycombs, and as an adult lives attached to the bodies usually of the adult queens, where they feed on the nectar or honey which they extract from the mouth of the host.

The concluding phase of honey bee evolution occurred about ten thousand years ago when man in his neolithic stage had reached such a level in his social development that he could observe and take advantage of the honey bee's ways. Apiculture spread widely in prehistoric times and within the geographic range of the honey bee, no people, savage or otherwise, are known who have not kept them (Wheeler 1923, p. 91). With the European settlement of America (Benton, p. 18), Australia, and the Pacific, honey bees were transported to those regions likewise, so that today the species is nearly cosmopolitan.

In retrospect, then, I have attempted to show the probable course of evolution of the honey bee from the first winged insect.

* Frank Benton, The Honey Bee, U. S. Dept. Agric. Div. Ent. Bull. 1 (N.S.) 1896, p. 14.

The line of descent has led through the plant eating Hymenoptera, the parasitic chneumon flies and the caterpillar-hunting wasp to the solitary bee. From this point we have tried to trace the further development through a series of more simply or-

ganized societies to the climax which is the honey bee. One by one we have watched that series of structures and habits being assembled which combine together to make the honey bee so marvelous and so useful to us all.

COLLECTING IN MEXICO

by David and Nelle B. Causey
University of Arkansas

These notes are offered for the use of anyone considering collecting in Mexico. They include information we would have been glad to have had some years past. We are not "old China hands" in Mexico. In recent years we have collected along most of the two coasts of Mexico. Inland we have collected along all the principal highways and a number of interesting detours, and from sea level to over ten thousand feet of altitude. Our major omission to date is Yucatan. We have met entomologists and ornithologists with more experience. We shall assume that you are using an automobile and that you have adequate background and field experience before you start, and that you have a little common sense. If you are the sort of person who will look for fish in the desert stretches or for orchids on a spray splashed rock on the seashore, you'd better stay at home and read travel books.

First of all, you will pass through the Mexican Customs. A letter from a high Mexican official will help, and we suggest that you go as high as you can. At the least, any consul along the border will give you such a letter if you call in person. Such a letter will not only impress the customs officials but also helps at the checking stations within Mexico. Since it usually explains who you are and what you want to do, the letter will save a lot of discussion. You should have one or more letters from your institution, say the president and the dean, with the same information. And at the first opportunity pick up one in Spanish written by someone who is Mexican and knows the Mexican people. We have a wonderful one written by a girl in a tourist bureau. She said, "I know many people. I'll write it so the fishermen understand." And they have all over Mexico. These letters of introduction breed rapidly. An official reads your letter, dictates an additional one to someone else, the number you gather is determined largely by how long you play the game.

Since you must clear with the U. S. Customs on your return, your letters from

your institution will help. Chances are, if you have really been collecting, you will look like Arkies or Oakies and your car will be filled with very suspicious looking stuff. The customs officers have the right to take your car, and you, too, apart if they deem it necessary. Just be nasty and you'll get the works. They are, however, hard working men of uniformly high caliber. If you tell him who you are, what you have been doing, and show them confirmatory letters, you won't have any trouble.

You need other papers, going and coming. The Mexicans ask for the car title certificate and your driver's license. They may ask for a vaccination certificate or a birth certificate, but usually not. You will need a tourist's permit to go into Mexico (\$3.00 per person) or a permit from a consul good for thirty days, which is issued to students and scientists as a courtesy (no charge). The U. S. Customs may ask for the birth certificate or naturalization papers, a smallpox certificate, and import certificates showing duty has already been paid on such things as German cameras. You can register such with them as you go in, if you have lost the certificates. We keep all such papers in labeled envelopes in a brief case and just hand out what is called for. If you are bringing back plant material or living animals you need special permits from the U. S. Department of Agriculture. Get them before you leave! We have had no trouble about alcoholic specimens or such dried specimens as mollusks, echinoderms, etc. They often want to look at them, but that's all. You may forget that there is a bit of fruit in your glove compartment and be embarrassed when they find it. That's all right, they know that you are human and forgetful. But for heaven's sake, no tricks. If they find a half pound of marijuana tucked away in some obscure corner of the car, they won't regard that as absentmindedness. And, my friend, they would have known about it before you got back to the border and be waiting for you.

We mention all this because the officers are really very decent and understanding and will meet you more than half way. But they have a hard job to do, and they do it. Another item — your American car insurance is almost certainly not good in Mexico, and you should get Mexican insurance before you cross the border. No law requires you to do so, but you can be very sorry if you don't. Lastly, in going through the Mexican Customs you will be expected, nay, often invited, to tip the officials as well as the smaller fry. Do it. It pays off in little courtesies or in more substantial aid. And you'll tip as long as you are in Mexico.

A tightly written little book on Mexico on the plan of Fenneman's *Physiography of the Eastern (and Western) United States* would be wonderful, but our geologists assure us that thus far there isn't anything of the kind. Likewise one on plant and animal ecology, with maps showing the broader features, zones, etc., would be a delight. There isn't any. The chapter in the *Naturalists Guide to the Americas* is the best we know of. A really good, up to date history which didn't stop with Mexican Independence (Priestly's is the best we know of) would be nice; also an up-to-date atlas would help. There are a couple of good books on the birds of Mexico, but no small one-volume approach to Gray's *Manual*. In fact, unless you can use technical papers on limited groups, you are pretty much on your own. Dr. Alvarez de Toro's *Los Animales Silvestres de Chiapas* is a regional survey of the type one wants many more of.

There are several guide booklets for motorists in Mexico. We think that Mexico, put out by the Automobile Club of Southern California is the best, with *Motoring to Mexico* by the Travel Division, Pan American Union next. We have a lower opinion of Mexico by Motor, put out by the American Auto Association. Our experience with the travel bureaus of the great American oil companies has been disappointing. Their maps are inaccurate, the road information is not up to date and apparently they are unaware that there is any difference between the dry season and the rainy season in many places when roads are concerned. You can go many places not indicated on the road maps. Depend upon local information, from motels and the filling station. And if you get lost, follow the next bus which passes you!

Even though all you know about a car is how to start and stop it, there are some

supplies which are advisable. Start with good tires and an engine which has been checked. Put tubes in your tubeless tires, and have a spare inner tube or so. Have tire tools, patching material and a boot, just in case. A tow rope and a two-or-three gallon can of gasoline will add to your peace of mind and you will almost certainly use the gasoline. For tools a screwdriver, a good pair of pliers — vise grip and big — and a few well chosen wrenches. And some parts — a fan belt, a spare fuel pump, a distributor cap and a distributor repair kit, a spare spark-plug, and a bit of ignition wire. If you don't know how to use this material, take it anyway. Almost any truckdriver who comes along does. And no Mexican will pass up if he thinks you need help. In the cities you will find garages with skilled mechanics and their prices are astonishingly low. But there are lonely stretches of a hundred miles or so where you will feel better if you have some spare parts. Last summer a man told us of being towed sixty miles because his fuel pump had failed, towed in a hard rain up and down the mountain road. He shuddered as he told of it. Most likely you won't even have a flat, but it is nice to be like a Boy Scout.

What you collect determines what equipment you need to take. It takes experience to eliminate the stuff you think you will use but never do. Our supplies are mainly vials and jars, alcohol and formalin. We have a cabinet with trays and cardboard spacers for the vials, and the jars are in grocery store cartons. Everything is in boxes and each box is labeled in big letters on all four sides. We carry a couple of three-gallon glass jars in the original cartons. One has part of our alcohol in it, the other a reserve supply of water. The rest of the alcohol is in metal gallon cans in cartons, and already diluted for use.

Collecting is fun in Mexico, unless you dislike field work. You can be in the mountains with only the road as an indication of human activities — no houses, no fields, no people in sight. You stop and start collecting. Comes a time when you straighten up, and there is an Indian silently watching you. You speak to him as a fellow human being in a lonely spot, show him what you are doing, and almost always he joins you in your collecting. He will know where what you want occurs, or may point out that it is the wrong season. Along the seashore the fishermen, tired from a night's work and eager to

get home for food and rest, will wait patiently until you have looked through their catch. And they usually refuse the pesos you offer in appreciation.

Bitter experience has taught us that we can't expect to get breakfast before we start out in the morning — the places just aren't open that early. The map shows a town fifty or a hundred miles away, O.K., we'll eat there. Then collecting turns out to be good and maybe we don't reach that town before noon! We've solved that with a little Swedish stove which burns kerosene. With it one can have coffee and a roll or two taken from last night's dinner. Of course the stove leaks kerosene over anything it touches, and you will run out of fuel. You can carry more supplies — say canned goods — but you will probably overdo it. It is nice to have supplies so an occasional meal can be fixed along the roadside, with water and food you can trust. And an occasional little town's only cafe will be so dirty you would rather warm up a can of beans. We try not to have to do it, we go to collect and not to cook along the wayside. The same goes for camping equipment. After ten hours of driving and rooting about in the undergrowth and leaf litter, rolling logs and turning rocks over, we just don't want to pitch a tent and set up house-keeping. We've tried it. You are too tired, and anyway, the time is better spent caring for your collection and records. But some do.

The well dressed zoologist in the field usually looks like an escaped scarecrow, and the female counterpart would probably go in the same genus. In Mexico you need sunglasses. Remember that most of Mexico is a high plateau, and tropics or not, summers are chilly and usually rainy. You can use ordinary weight clothing, and in the evening a sweater is fine. Should you clean up and go out in the evening, a top-coat is often nice, especially in Mexico City. Along the coasts in the hot, sticky *tierra caliente*, you will want lighter clothing. But not shorts. There must be insects in Mexico which don't bite or sting or both, but you will come to doubt it. And only experience will convince you of how many ways plants can scratch and cut you. Many also have stinging hairs which take your mind off collecting at times. Insect repellants and soothing ointments are fine, but one usually forgets about them until too late, at least the repellants.

Here is advice you won't take. We don't follow it ourselves. Leave your cameras at home. We carry two, one for Koda-

chrome and the other for black and white film. You worry all through the trip about what the heat is doing to your film, and there are places where it suffers. We met one man who had a mechanical refrigerator in his car just for film; it had the cooler mounted in front of the radiator, the compressor under the hood, was driven off the fan belt, and the box was in the trunk. It's a temptation! Cameras, film supply, filters, extension tubes, light meter — you know what it is if you are serious about photography. It takes at least fifteen minutes to stop and get a couple of good exposures, and usually you can't afford the time. We get ours while one is taking care of the specimens and making field notes before starting on again, or when there is a spare hour or so in a town. Usually that is late in the afternoon and the light isn't right for color. You will torture yourself all through the trip about the ones you are missing. The finest of these are those which come up when you leave the gadget bag in the car because you aren't going very far. But the pictures you do get are very nice when you are home again.

A few words about the health situation. There are certain things you can do to lessen your risks. Smallpox vaccination is required, typhoid shots are always wise. We take chloroquine tablets once a week when in malarial areas. We have debated getting yellow fever shots for years and haven't done it yet. It means a trip to a U. S. Public Health center. Your main trouble will probably be some type of dysentery. Any Mexican drug store will have Entero-vioformo tablets. One a day is supposed to be a prophylaxis against amoebic dysentery. That means that when you do get dysentery it is probably some bacillary type. Tri sulpho tablets will take care of that, or one of the faster working antibiotics. (This profound discussion of ways of coping with dysentery is based upon a discussion in Mazatlan with a brand new University of Utah M.D., who added with a grin, "At least that's what the books say." So far as we can tell, it works.). All in all, aside from dysentery, you run little more risk than you do at home. And our Mexican friends tell us that they get dysentery when they come to the states!

And long lastly, if you collect in Mexico you are going to meet people rather intimately, often people not accustomed to tourists. Be *sympatico*, which means a lot of things, to be friendly, decent, and either lady-like or gentlemanly in your attitude

toward them. After all, you are a guest in their country, and a guest has certain obligations. A smile, a handshake, a stray peso or so now and then when a favor has been done you and you'll get along. A little knowledge of Spanish helps, even a phrase book, and a lot is still better. In towns, if you speak English to one who doesn't understand he'll raise his hand, hurry away and be back in a moment with someone who does. The Mexicans are grand people and you'll like them. Two lady Spanish teachers who have been traveling all over Mexico by bus, summer after summer, told us they always felt safer in Mexico than in the States!

We went to Mexico again this last summer (1956). There was the desire, of course, for more millipeds and more parasitic copepods. There was also a humanitarian purpose; we wanted to find out if there was some way of getting into Mexico without having to go through Texas. It can be done. There is the little matter of driving 2,000 miles from Fayetteville to San Diego if you enter at Tijuana, as we did. That involves going through New Mexico and Arizona. We were lucky in getting through in the early summer before it began to warm up. We only encountered 110° to 115°F. I shall long remember Nelle's exclamation as we entered one desert stretch, "This is worse than western Texas!" After collecting in Ensenada and trying to in San Felipe in Baja California, we crossed northern Sonora to Sonoyta. From here we went to Puerto Penasco to collect a few days and back to Sonoyta. At Sonoyta we heard such harrowing tales about the road to Santa Ana that we chickened out and reentered the U. S. to avoid it. Arizona had begun to get hot by then. We reentered Mexico at Nogales, went south through the relatively cooler Sonoran desert to Hermosillo, and then to Guaymas. From Guaymas we went southward to Mazatlan, and from there on we were retracing the previous summer's collecting path — San Blas, Guadalajara, Morelia, and Mexico City. And ultimately home by way of Victoria and McAllen, Texas. At the present time I admit there is no better way into Mexico than by Texan highways, preferably in an unconscious state.

Any generalizations about Mexico will turn out wrong, including, no doubt, this one. But, as far as our experiences in upper Baja California went, it was so Americanized that it was difficult to believe that we were south of the border. The

people almost always prefer to speak English, U. S. money is preferred, and the very food you eat has been trucked in from San Diego. Even the pig skin from which the crispy cracklings are made and sold by vendors on the beach come from there! At the motel the lady expressed strong disapproval of the Mexican government's attempt to induce them to buy electrical appliances made in Monterey instead of the same brand brought in from California. Most of the people you encounter on the beaches are visitors, usually from California, who have come to Baja California to fish or to enjoy various aquatic sports. You see a lot of skin divers. Fishing is good at Ensenada and more or less so all along the Mexican Pacific coast, but I am firmly convinced that one can find better fishing from piers or boats along our Gulf of Mexico coast at least 365 days of the year, e.g., at Grand Isle, La., or Port Aransas, Texas. I can say this so fearlessly because I have no intention of ever going through our great southwest again — not in this life. Possibly as a disembodied ghost I may find the ventilation adequate and occasionally drift through it to pass time, but I doubt it. There are so many people I'd like to haunt, Padre Keefe for example. I'd like to send a wintry blast down his neck every time he puts off answering a letter!

The rocky shore at Ensenada is fine for marine collecting, reminding me of the richness of Pacific Grove, California, many years ago. An hour at low tide gives you a nice course in marine invertebrates: snails and pelecypods, chitons and crabs, sponges and tunicates; and barnacles and worms and — see any textbook! I got nice color pictures of the big anemones, both when expanded and looking like anemones, and when contracted and looking like a cluster of white pebbles. Copepod collecting was good, we got twenty-six collections here and from a variety of fish, exploiting as usual the sports fishermen, both those who went out in boats and those who fished from the piers. And we had a new experience here. After we had taken copepods from a nice fish as the owner watched in dismay, he refused to take it back. Our landlady enjoyed it that evening. Ensenada is a nice little town, with the usual statue of Juarez and a bookstore. We bought a Spanish edition of Don Quixote with nice illustrations and the proprietor embraced me because of our good taste in literature.

It is possible to cross the peninsula from Ensenada to San Felipe, but we got broad

grins and head shakes when we asked about it. When a Mexican advises you not to take a road, don't. He knows what your car and you can do. So we went back to Tijuana, and then by way of Mexicali, crossing the backbone of Baja California. It was nice but not impressive to one who has been in our Rockies. San Felipe is on the western side of the Gulf of California and a bit over a hundred miles south of Mexicali. The road to it is a lonely stretch with scarcely a village on it, with the mountains to the west and the gulf to the east. There was a limited area of nice sand dunes, white, and so textbooky in shape as to almost seem artificial. You can see bigger and better ones in our own southwest. I like sand dunes, they are among the things which are seen and are temporal, like wave ripples in the sands of a beach, and preach their little sermons.

San Felipe was a disappointment. It is beautiful, the blue mountains on the west sort of crowding it towards the white sands of the beach. The water is blue and the sky is blue. The motel has a number of water colors of the area on display — someone else had found its beauty. But it is just a little fishing village and we had to arrive in the off season. No fishing, no fish. We did see a few in an ice house, but they had been gutted and the gills removed, so were of no interest to a parasitologist. There is a little shrine on a rock near the beach, so small that the picture I took of it and of Nelle standing beside it looks like a church with a very modern colossus. And a little notice asking contributions be put in the box. How long that poor padre will have to wait for his church!

The postoffice was also the jefe's office, the police station, a sort of local club, and a place to store odds and ends. We began to understand why mail is sometimes so uncertain in Mexico as we watched people come in, go through the mail, discuss with considerable interest what certain packages might contain, and in general render futile the efforts of the two girl clerks who were trying to get it sorted out. There was a poor sea turtle on its back in the rear of the building (no barnacles on it), and a couple of stuffed bulls with the remains of fireworks on them. There had been a carnival a few days before. We were assured we'd see lots of fish if we stayed on a week or so. I asked the motel proprietor about the great tidal bores the books describe coming up the gulf with speed and grandeur — walls of water. He said that they didn't have them anymore, not since the Colorado river had quit flow-

ing, for any practical purpose, into the gulf. We didn't see any, either at San Felipe or almost directly across the gulf at Puerto Penasco a few days later. All we got from San Felipe was a few barnacles chiseled from the rocks along the shore.

To Mexicali and on to San Luis, and then Sonoyta. There we refused to stay at a motel so new it wasn't even completed, and being built the way they were twenty to thirty years ago, guaranteed to have no ventilation in an area where it is almost as essential as the air you breathe. We found a hotel of still older architectural vintage, run by a lady in deep mourning and with a sepulchral voice. If it had had a courtyard it could have been in La Mancha. The last thing I heard before I fell asleep was Sancho Panza asking, "¿Hay cuarto?" and her mournful voice replying. Next morning we got away early and stopped in the shade of a roadside stand to cook breakfast. That brought out the people who ran it, and they kindly helped us shield the stove which was threatening to either blow up or burn down the stand. I remember this because I bought Mexican cigarettes from them, and later on, when I offered one to a poor beggar he refused, saying "fuerte!"

Puerto Penasco is a real old new town, going back about two human generations. We stayed in the hotel which was the first building erected there and listened to stories about the town from the wife and daughter of the man who founded the town. Every drop of fresh water is hauled in for miles. An Arkansas fog wets one more than the showerbath did. Nelle claimed she soaped herself under the shower and rinsed off with a glass of water, a feat I think would be good on T.V. I just went dirty. Puerto Penasco is mainly shrimp, with a little commercial fishing. We saw few fish there, but near by at Cholla Bay the fishing was good. Americans from New Mexico and Arizona come there with boats and trailers and have established a sort of "Arkie" camp. Only a limited number of species of fish were being caught and brought in, but occasionally we talked some kindly fishermen into saving a shark or other "worthless" fish which we prized. The tide here is maybe six feet, and at low tide a large area of rocky bottom is exposed. Almost any kind of bottom dwelling invertebrates was to be found. I'm still giving away sand dollars from there — the nearest to being a philanthropist I'm likely to achieve. The road from Puerto Penasco (Americans call it Rocky Point) to Cholla Bay is just two ruts in the desert sand. I got stuck

in the sand, so far as I could see, for keeps. A car of Arizona cowboys came along, looked the situation over, and then just picked up the rear end of the heavily laden station wagon and set it onto the harder part. They waited long enough to see that we were on our way and were gone. I hate to admit it, but I got stuck again a couple of hundred yards farther on. A happy group of Mexican boys pushed us out of this, partly out of kindness and partly because they couldn't go any farther unless they did. And Mrs. Causey drove that road every day for nearly a week after that without any trouble at all.

We went back into Arizona from Sonoyta after a bit of annoyance with the only stupid U. S. Customs man I've met, and back into Mexico by way of Tucson and Nogales. Here we had trouble with the Mexican Customs. Our papers weren't properly authenticated — I'd been trying to get it done from Tijuana on — and this was the last chance. The man who was supposed to do it was home having a siesta, and the man on duty was mad at the one taking a nap and wouldn't telephone him to get permission to do it himself. We could just wait until he woke up and came back, probably the next day. I threatened to report it to Mexican Embassy at Washington, from which I had a letter, and they didn't like that idea at all, but they held firm. Then Mrs. Causey took over, and in her sweet way implied that they were acting like children instead of grownups. It stung, a hurried telephone call was made, authority given, our papers were stamped and we got to Hermosilla that evening. The Sonoran desert was disappointing. No nice sand dunes along the road, just cacti, a few birds and an occasional dead snake in the highway. Probably a roadrunner or two, I forget. An inch of rain and it would have been a wonderland for a short time — not the Disney Hollywood type — but still a wonderland of tiny flowers, insects, and **MILLIPEDS!** We've seen the Mexican desert that way.

Hermosillo is attractive. A brand new motel run by a man who said he was German, from a part of Germany where they don't speak German. At least he didn't understand my German. I've found Spaniards who don't understand Spanish. Come to think of it, many of my students don't understand English. There is a fine, clean market, a couple of interesting churches, and the very new university. Science as we think of it is apparently almost non-existent, except for some chemistry. One of the professors told us

the emphasis was on archeology and history and that their museum wouldn't be open until fall. I'm sure he hadn't ever heard of copepods or millipeds. There is a nice library with about twice as many books as we own personally. And believe it or not, I saw a couple of students reading books in it. Here at the University of Arkansas the only part of the library the students use is the front steps. For making dates, stupid! Then a hot drive on to Guaymas and another motel.

Guaymas was disappointing. A nice little town with friendly people, and supposed to be a great fishing center. I suppose it is. But we worked down from the Jefe through what I suppose was the Secretary of the Chamber of Commerce for Fisheries to a couple of fishing plant managers, collecting letters of introduction all along the way. They did have fish, usually just three or four kinds, and practically all gutted and the gills removed. Of course they had thrown the "trash" fish away before they came in. We got a few copepods but there wasn't much right with the world just then. So we turned to the sports fishermen. Usually they came in with sailfish and dolphins, and one soon gets all the copepods he wants from those two. We found a group from Loma Linda Medical School at the nearby Miramar beach. They were skindiving for puffers, which they froze to take back to study the poison in the livers. They were very kind, and thanks to them we had a chance to examine some fish we might not have seen otherwise. They even gave me some information about a couple of Loma Linda students I'd had in class in my Berkeley days, but I felt they looked at me as though I asked about people in the Yuma area in the days before the Aztecs started south. Sometimes I feel ancient.

It is mainly desert between Guaymas and Culiacan, part of which is being prepared for irrigation. One drives through miles of an area where bulldozers have scraped off the cacti and piled them up for burning, where huge canals have been made, all laid off in broad fields and straight lines. There won't be any man with a hoe there. It was an artificial dust bowl, with plenty of it. If the Mexicans can find enough water to irrigate this area, and I expect their engineers have thought of it, we shall be getting more than tomatoes from Sonora, and the Mexicans will be well along toward piling up food surpluses of their own! And parity and what your party did and what my party would do. Anyway, it is a gigantic

project and reminds one of the story of what God could have done if He only had the money. We got some toads and a frog at Culiacan that evening for a silly friend who studies them instead of millipeds and copepods.

Mazatlan and old friends. We met Mr. Bennett on the street, going on 91 now, who recognized us instantly and reminded me I didn't know how to spell my own name correctly (his opinion!), visited with the girl at the tourist bureau who has helped us so much; talked with the lady who runs a fishing fleet. I don't know what there is about us (no editorial insertions here, Padre!), but people we don't recall ever having seen before come up, shake hands, and say, "We remember you from last summer." Fishing was as brisk as it was last summer, unfortunately they were getting the same species. We collected more copepods. And we ate again at the same disreputable joint, got the same dysentery as last summer. I may go back to Mazatlan but that place has lost a customer.

San Blas and a few more copepods. Mysterious car trouble since Mazatlan, irregular motor which finally quit for keeps on a lonely stretch to a beach. I had exhausted my ideas when a Mexican came along, stopped, asked for a screwdriver, took off the distributor cap and tightened the points which had worked loose. He paused long enough to listen to the engine purr, then a flashing smile and a little bow and he was off down the road in a cloud of dust. How he knew that the points were loose in a dead engine is something I like awake nights wondering about. San Blas is a tiny fishing village whose existence these days seems hardly worth while. It is in the true *tierra caliente*, with rank tropical vegetation. It is hot and sticky. Not even ice for the Moctezuma or the Carta Blanca. I can take it or leave it, but Nelle loves San Blas. In case you have been there in recent years, you might be interested in knowing that fate caught up with Jungle Jim. He was fired and is now giving some other part of Mexico the benefit of his talents.

Tepec and recovering from the dysentery! We stayed over because of the heavy rain, *hurracaine* on the coast just after we left San Blas. We visited the cathedral, the Museum of Archeology, which has some fine pottery figures and a lot of old Spanish stuff, and bought some books. We also visited the Church of the Cross, the place where local tradition says Father Serra prepared for his California trip.

The cross is raised just a few inches above the level of the rest of the court which communicates with the church itself, and is rather neglected in spite of the local pride in him. I imagine a grass cross, with a few weeds, is a fitting memorial to a barefoot friar who walked the Sonoran sands and the rocks of Baja California to carry his mission to California. I never did find out if he is buried there and haven't got around to looking it up. There was a temporary gasoline shortage at Tepec and it gave us a welcome excuse to stay over another night. Tepec would be a nice place to live for awhile.

From Tepec to Guadalajara. Stopped at Ixtlan to see a temple. Not worth the wear and tear on one's legs. Stopped again at Tequila to buy some tequila for some low-life friends. It's made from an agave. The big leaves are cut off and the base then looks something like a gigantic pineapple. You see truck loads of these along the highway, and of course many fields of the plant. At Tequila these bases are crushed, the juice drained off and fermented, and then the ancient spirit of the Aztecs is distilled from it. It costs slightly more than bottled water, and if I recall correctly the Texan tax per bottle is more than the original cost. That tax on Mexican firewater is the most unpopular thing Texas does from the tourist viewpoint — I've heard them complaining about it all over Mexico. If the state weren't the most desperately poor in the country I'm sure they would do away with it. While at Guadalajara we went to Chapala on Lake Chapala to see if Mexican freshwater fish had copepods. No fishermen in sight, no sports fishermen. Found catfish and carp in the market and got leeches off the catfish. No copepods. I might add that judging from the way the water level is dropping, if you want to see Lake Chapala you shouldn't put it off too many years. There are broad fields where there used to be lake bottom. Guadalajara has a cathedral worth visiting, and the State Library is interesting, both the building and the collection of old books and old manuscripts. The Orozco Museum is worth a little stop Guadalajara is the second largest city in Mexico and a favorite place for Americans to retire — just about the right altitude, fine climate, etc. I'd rather live in any of several other places if the time ever comes when the good people of Fayetteville drive me out.

There is an interesting State Library at Jiquilpan. It has beautiful bronze doors with bas reliefs of Latin American literary

people. Inside are a few books, in locked cases, some Indian relics, murals by Orozco, and a collection of insects which the curator wants to sell. Apparently the library is also a school and this is a student collection. We had looked forward to another visit to Morelia. It was a dismal failure, and the enthusiasm we had built up disappeared. It was the same city with the same wonderful cathedral, although apparently the old bishop had gone the way of flesh and has been replaced by a younger one, the same wonderful organ. We even had the same room at the same hotel, a fascinating place where the old courtyard in which the mules formerly were tied up for the night has metamorphosed into a lobby, etc. We had a poor dinner, which has a lot of influence when one is tired and irritable anyway. So often a second visit doesn't pan out as one expects. I suppose a lot of intangibles enter into this. Next day on again in the rain to Zitacuaro where we put up early. We paid sixty-four cents for the room in the hotel, and parked the car on a tiled patio floor!

Mexico City! We waited over an hour to see the new Archbishop arrive at the cathedral to be installed and I got pictures of his head and shoulders, so far as I know that is all of him! I felt sorry for the little press photographers who were holding their cameras high over their heads and shooting blindly. The wonderful National University and the sun was shining that day. I was taken up fourteen stories to the roof of the library so I could take pictures. And the little reference librarian who spent most of a day locating an obscure village where an important milliped had been first found, and who brought the information to us at the motel that evening. I'm still telling our reference librarians about her. The Polytechnic Institute and Dr. Bolivar (yes, it is the same family and each generation has a Simon). He is Spanish, a refugee from Franco's Spain. He is an entomologist, and has the greatest knowledge of the phylum Arthropoda I've ever encountered. He talked millipeds with Nelle as though he had worked on them for years, little details about mouth parts and gonopods and then turned to me and talked about parasitic copepods

as though they were his speciality. I don't mean knowing a few textbook names of genera but the knowledge which comes from working with them and studying the literature. I asked him how he knew so many genera of Arthropoda. He smilingly said that the first 5,000 were hard to learn, then the rest came easy! His son-in-law, Dr. Carranza, is a Michigan trained ichthyologist from whom I have high hopes in the copepod way. They had us in for dinner one evening. The cake was shaped like a milliped, with chocolate metameres and legs. Nelle purred. We visited the zoo, which was like other zoos, and were disgusted with the way the botanical garden was neglected. Maybe it is more difficult to keep plants alive and healthy than animals, but I think they ought to do almost as well with their native plants in a botanical garden as the plants do on their own along the highways. Went to the American Colony's Fourth of July celebration, held on June 30th., and ate too many hot dogs. There was the Shrine of Guadalupe, the National Pawn Shop, many churches — places we have been putting off seeing in past years. Pictures of everything, color and black and white. I've had a traffic cop stop traffic long enough for me to get to a suitable place to photograph a statue and acknowledge my thanks with a friendly wave.

We revisited the pyramids on the way home. The restoration in the past twenty years is unbelievable and, personally, I suspect the pyramids have been so improved that an old Toltec dropping in wouldn't recognize the place. I bought two of the newest phony antique figures in existence, so new they hadn't even been buried awhile. I would have had a third but Nelle flatly refused to take her dress off and trade it for the third. I'm rather proud of my Toltec Queens of the Sun and the Moon — they look something like sandstone nightmares. The usual attempt at the Jacala filling station to cheat us. Arranged at Tamazunchale to get a Sancho Panza wood carving to match last summer's Don Quixote. Victoria and the fine old friends at the hotel. And home, as usual, the best part of a trip. Adios, amigos!

CHAPTERS, OFFICERS AND ACTIVITIES

— See Frontispiece, p. 4 —

Guilford College
North Carolina
August 13, 1956

Dr. A. M. Keefe
St. Norbert College
West De Pere, Wisconsin

Dear Padre:—

Your letter of July 29 was forwarded here where we have settled for the rest of our lives. It was good to hear from you and quite flattering that you want something for *The Biologist*. The gang in Chicago gave us a grand send-off. About 120 people were at the dinner, including Charley and Margaret Best of Toronto. He was the principal speaker. I was quite overwhelmed by the magnitude of the affair. The Committee that arranged it presented me with a bound volume of over a hundred letters — University president, vice presidents, deans, Nobel laureates, several presidents of the American Physiological Society — really quite a breath-taking galaxy. The Departmental staff gave me a nice radio and the freshman and sophomore medical classes gave a monogrammed travel bag. And just today I received from one of the boys a couple of dozen Kodachrome transparencies taken during the dinner. By the way, one letter was from Erwine Stewart. Another from a man who went to my first country school just 50 years ago. He is now Professor of Crown and Bridge in the Dental School at Ohio State. Still another was from Walter Meek at Madison.

I shall send to you two prints and you can use the one you think best. The larger was taken, probably 15 years ago. Neither of us can recall the circumstances nor the exact date. The other is a proof taken by

our own illustration studio just a few weeks ago and probably looks more like me as of now. It has not been retouched at all. The photographer has not yet sent the picture itself. He just took it because he wanted one for himself; he is not printing any for distribution.

This closes 45 years of teaching physiology, 28 at Illinois. Besides grade school experience in three schools, I have taught bacteriology and pharmacology briefly but have concentrated on teaching physiology to medical, dental, pharmacy, nursing, veterinary students, undergraduate college students, home ec. specials, graduate students, major and minor — I even gave a few lectures once to some undertaking students! I now come up with the strong conviction that physiology must become one of the most basic aspects of education and that the medical schools must participate in the education of teachers of the various branches of health education. The teachers' colleges cannot provide trained teachers because they, in turn, lack trained personnel for the job. The medical schools have pre-empted the cream of the physiologists and so its best development has become associated with medical education exclusively. That must change. The better the lay public is educated in health matters, the better job the physician can do. Medicine made little progress in this country until the public learned to understand and appreciate its possibilities.

In the next few days I shall try to compose something you can use. Meantime, thanks for your good letter. Write again and tell me all about yourself as a person. Aside from your name in the *Biologist*, I don't know very much about you of recent years.

Sincerely,
Carlos

Dr. Lagler Represents Phi Sigma At A. C. H. S.

On February 12-23 I represented Phi Sigma at annual Association of College Honor Societies. Henry vander Schalie attended the luncheon meeting with me as did Mary Seaman, Vice-President of Beta.

Programs are attached. The formal talks were excellent and supported the views (1) that a liberal education is most important provided that it uncovers ideas while covering the many fields of learning; (2) that

honor societies have a real and time-tested role in the maintenance of high goals in scholarship.

Council business was routine. Organizational summaries of the societies, their costs, and problems are being sent to Orcutt.

We can continue our pride in membership in the group and must not fail to continue it.

Alpha Iota's Anniversary
(See p. 67)



SEATED: Dr. Wayne E. Manning, Professor of Botany; Miss Mary J. Pohala, '44; Dr. Roy C. Tasker, Professor of Biology; Mrs. Roy C. Tasker; Dr. Norman H. Stewart, Emeritus Professor of Zoology; Mrs. Norman H. Stewart; Dr. Hulda Magalhaes, Professor of Zoology; Dr. Roger W. Bowman, Professor of Physiology. 2nd ROW: Mrs. Ellwood Kerstetter, Mrs. Amber Leibensperger, Anna Marie Pakoskey, Sally Smith, Anna K. A. Kerschner, Helen F. Oman, Barbara Clements, June Wildhack, Dorothy Reichard, Fu Lane Wong, Marian N. Brice, Dr. Karl F. Lagler. BACK ROW: Robert Rudin, Dr. George J. Schumacher, '48, Ellwood Kerstetter, '37. Bruce T. Leibensperger, '32, Robert B. Taylor, Frederick L. Whipple, James L. Yarnall, Richard K. Ziegenfuss, Paul L. Crawley.

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ALPHA CHI CHAPTER IN RETROSPECT¹

University of the Philippines Quezon City, Philippines

by Gregorio T. Velasquez (2)
(Associate Professor of Botany)

The Alpha Chi Chapter of the Phi Sigma Biological Society may now rightfully bow to the public with pride after its inauguration on March 12, 1949 at the mother institution, the University of the Philippines. Nine of its members have already become recipients of the distinguished science service star, the highest award so far given by the Republic of the Philippines. This constitutes forty-five per cent of those who were given so far in the country's men of science within the field of natural sciences. Indeed, it was the most reminiscent occasion during which the quality of scientific work in the country received its first national recognition, so very sparingly done, which the members should emulate while they forge ahead with similar objectivity.

Since the establishment of the Society, at least a dozen members of the Alpha Chi Chapter have successfully met the master of science requirements in the University of the Philippines. When the Institution started five years ago to offer courses leading to the further encouragement of still more talented students towards the doctorate of philosophy, the only successful applicant was a member of the society. Such an almost exclusive accomplishment speaks very highly of the academic quality of the members taken into the folds of the organization. In the United States of America, another dozen members have equally done excellent performance, so much so that at least half of them have been encouraged to embark into the program of the doctorate of philosophy on their chosen specialization. Reports have been received continuously which state that so many other members at large are teaching biological subjects in high schools, colleges and universities in the country. The characteristic of good teaching which reflects from the thorough foundation of biological training in the University of the Philippines is an excellent step towards the encouragement especially of the youth in the country for

the proper appreciation of natural sciences. It has now become the role of the Alpha Chi Chapter to help enrich the atmosphere of scientific development in the country. Many other members are occupied in the implementation of the fishery program in the rural places while others are leaders of biological thought such as the directors' or advisors' position in government and private establishments. Indeed, the greatness of the Alpha Chi Chapter has been marked by the various work of members dedicated to the steady improvement of human knowledge. Progress in the biological sciences should take an important role in the scientific activities of the Philippines in order to play an effective part in the development of the Southeast Asian countries.

In passing, however, we should not forget that the membership in the Alpha Chi Chapter should have its distinct evaluation. It is through the attendance in meetings of the loyal members and the full discharge of their responsibilities to assigned work and payment of annual dues that the aims shall be better accomplished. But the success of the society in the various fields of biological pursuits in only seven years of its existence have more than compensated this routine. Are we not proud of this membership? May the organization therefore out of the present fruition continue to advance its footsteps towards the common objective of propagating in the country the interest in research in the biological sciences! To unravel the secrets of nature is of course very slow, since this opportunity is not a common possession of all. So with the infinite vastness of the universe, let von Baer speak to us: That "Science is, in its source, eternal; in its scope, unmeasurable; in its problems, endless; in its goal, unattainable."

1. Message given to the society on the occasion of its seventh anniversary. March 18, 1956.
2. Adviser and National Council Representative.

(Chapter news printed here is supplied by the Chapter Officers. Names of members more or less recently welcomed into Phi Sigma are furnished through the courtesy of the Council Secretary-Treasurer.)

BETA

—University of Michigan
Ann Arbor, Michigan

President: John B. Burch, Zoology Dept.
Vice-President: Mary E. Seaman, Botany Dept.

Cor. Sec.: Charles H. McNutt, Anthropology Dept.

Rec. Sec.: Claire L. Schelske, Zoology Dept.

Treas.: M. Joseph Klingensmith, Botany Dept.

Editor: James W. Hardin, Botany Dept.

Council Rep.: Dr. Karl F. Lagler, Fisheries (177 copies to Dr. Lagler)

There are many of us on the Univ. of Mich. campus either actively engaged in research on tropical floras, faunas or diseases, or just have an interest in this exciting and relatively unknown area. For the academic year 1956-1957, the central theme for Beta Chapter's programs will be **The American Tropics**. Among the Michigan faculty, there are a number of specialists on various aspects of research on the tropics who will present the formal talks. With such varied topics for each meeting we feel that botanists, zoologists, geologists, geographers, bacteriologists, anthropologists and others alike will welcome such a series of talks and discussions. The programs are given below.

Oct. 4 — Geography, Geology and Climatic conditions of the Amer. Tropics, Dr. L. C. Stuart, Dept. of Zoology.

Nov. 1 — The Flora of Brazil; Ecological work in the Tropics, Dr. S. A. Cain, Dept. of Conservation.

Dec. 6 — Some Aspects of Zoology in the American Tropics, Dr. T. H. Hubbell, Museum of Zoology.

Feb. 7 — Archeological research in tropical America, Dr. J. B. Griffin, Museum of Anthropology.

March 7—Ethnology in Tropical America, Dr. E. R. Service, Dept. of Anthropology.

April 4 — Tropical Diseases, Dr. R. J. Porter, Dept. of Tropical Diseases.

We feel extremely fortunate to have these men on campus who have such an interest in this relatively undeveloped field of biological research and who have had recent experience in this field.

On December 9, 1956, the following were inducted: Max Eugene Adler, Joseph Thexton Armstrong, Jr., Theodore Fairbank Beals, Charles Beverly Beck (Faculty), Silvestre Valera Bersamin, Donald Ernest

Bianchi, Samuel Haold Black, Bruce Reeves, Brandell, Annye Cannady Buck, Munir Kiriachose Bunni, Bernard Ladu Clausen, Hewlette Spencer Crawford, Jr., Gayle, Marcella Crosby, Kenneth William Cammins, Bonifacio Capili Daze, Alice del Campillo, Rita Mary Des Armier, Arlan Lee Edgar, Paul Russell Elliott, Romance Lorentz Fredrichs, Patsy Ann Gerstner, William George Gordon, Esther Marianne Goudsmit, George Linden Greene, Richard Louis Hauke.

Harold Franklin Heatwole, Herman John Heikkinen, Mimi Ho, Roy D. Hudson, Peter Arthur Hyppio (Faculty), Anne Louise Jackson, Arthur J. Jelinek, Clare C. Johnston, Ronald Ormond Kapp, Peter Bishop Kaufman (Faculty), James John Keleher, Reed Alan Kepner, Richard Stanley Kowalczyk, Makoto Kowta, Louis Joseph Laux, Jr., arold Dean Mahan, Jerry Allen Martinson, Andrew McClary, Donald Curtis McNaught, John Thomas Mickel, Donald William Misch, Paul Charles Munding, James Albert Organ, Wendell Hillman Oswalt, Paul J. Niehaus.

Richard Janvier Porter (Faculty), Jean Hayes Ramsden, Aban Jehangir Randeria, Judith Anne Rising, Richard Bruce Root, George Washington Saunders, Jr., Miguel Antonio Schon (Schon), Margaret Karges Segur, Priscilla Hollister Starrett, Howard Jay Stein, Robert Clayton Tharratt, Laura Belle Tweedie, Fritz Bernhard Volbach, Harold Joseph Walter, Adrian M. Wenner, Marvin John Whalls and James Stewart Wilson.

During the 1957-58 scholastic year the following will guide the destinies of Beta: Arthur W. Cooper, Botany, President; M. Joseph Klingensmith, Botany, Vice-President; Reed A. Kepner, Zoology, Rec. Sec.; Rose A. Overstreet, Botany, Cor. Sec.; Gayle M. Crosby, Zoology, Treasurer; Paul R. Elliott, Zoology, Editor; Dr. Karl F. Lagler, Council Rep. and Fac. Adv.

Phi Sigma Award Certificates are being presented to Yi-chi Mei and to Richard Louis Hauke, both graduate students.

EPSILON

—University of Denver
Denver, Colorado

Prseident: Neil S. Jacobsen, 1432 Downing, Denver 18, Colo.

Vice-Pres.: Gunther Schlager, 1480 S. Bryant, Denver, Colo.

Sec.-Treas.: Elaine Lavonne Munson, 7600 E. Colfax, Denver, Colo.
Council Rep.: Dr. Frederick Zeiner, 1417 S. Elizabeth, Denver, Colo.
 (20 copies to Dr. Zeiner)

On 10 April, 1956 Epsilon initiated:
 James Frederick Arnold, Phyllis Louise Barry, Francesco Lombardo, Martha Ann Holingson, Frank Swancara, Jr., Mary Ann Thulin.

ZETA

—University of Wisconsin
 Madison, Wisconsin.

President: David Bayer, Moore Hall
Vice-Pres.: James Harbeck, Birge Hall
Sec.: Ann Holtan, Birge Hall
Treas.: Patricia Borden, Birge Hall
Editor: Raymond Herrick, Hiram Smith Hall

Fac. Adv.: Lowell E. Noland, Birge Hall
 (225 copies to Ann Holtan)

New members as of May 9, 1956: Peter William Aschbacher, John Arthur Avery, J. Edgar Braham, George Joseph Breska, Edward Thomas Cawley, Macie Richardson Collins, Herman Glenn Cooke, Richard John Delorit, Robert Homer Ellis, Betty Ann Fenner, Lawrence David Friedman, Glenn Edward Maas, Raymond B. Herrick, Klaas Hoen, Ann Coffeen Holton, Victor Robert Huebner, Charles William Huver, Allan Ai Ichida, Bernard Meyer Israel, Elaine Margaret Johansen, Philip Arthur Jones.

Robert Carl Koeppen, Kam Choy Leong, John Leonora, Horace Michael Mazzone, Ralph Gerald Mitchell, Helmut Charles Mueller, Ruta Pokornijs, Jerome Alan Reinstein, Dwljendra Nath Roy, Nancy Alice Schneider, Bartley John Sciarraone, Anthony Peter Simonelli, Irvin Odell Skoyen, Theodore D. Sokoloski, Raymond George Stross, Jr., Thomas Wesley Sullivan, Gordon Everett Van Riper, Henry Thomas Vincett, Virginia May Vivian, M. Ann Waldorf, Leo Marcellus Walsh and David A. Wiekert.

The 1956 undergraduate Award Certificate went to John W. Suttie; graduate award to Mildred M. Smith.

ETA

—University of Akron
 Akron, Ohio.

President: Raymond T. Damian, Dept. of Biology, Univ. of Akron
Vice-Pres.: Thomas Riley, Dept. of Biology, Univ. of Akron
Sec.: Lois Ahl, Dept. of Biology, Univ. of Akron

Treas.: Henry Koerber, Dept. of Biology, Univ. of Akron

Council Rep.: Walter C. Kraatz, Head, Dept. of Biology, Univ. of Akron
 (20 copies to Dr. Kraatz)

Initiates for Eta Chapter, dated June 13, 1956: Grace Caroline Kimball (Faculty), Mary Molan Cheng, Janine Ann Harrison, Barbara Delores Hlass, Martin I. Kaye, David LaChance, Pete Lagios, Richard David Patterson, Linda Lee Thompson, Richard Earl White.

Award at University of Akron, June, 1957. Undergraduate to Martin I. Kaye.

KAPPA

—University of Kansas
 Lawrence, Kansas

President: William Hausler, Bacteriology Dept., Univ. of Kansas

Vice-Pres.: Tom Truffelli, Bacteriology Dept.

Cor. Sec.: Clarence Harms, Zoology Dept.

Rec. Sec.: Harold Murray, Zoology Dept.

Treas.: Richard Consigli, Bacteriology Dept.

Editor: Wilford Hanson, Entomology Dept.

Council Rep.: Mrs. Ruth E. McNair, Biology Dept.

(120 copies to Wilford Hanson).

Mr. Hausler requested that I also send you a list of all members of our chapter; this will follow shortly. We have one hundred members at present and that number of *Biologists* will suffice. We plan to initiate about thirty new members this year so we will need more copies later on in the year.

Initiated Dec. 11, 1956, Dilbagh Singh Bariana, Andre Richard Brillaud, Dennis LeRoy Carr, Yun Sung Chough, James Everett Deacon, Willard Willis Dean, DuWayne Cleveland Englert, Johnita Beth Forssberg, Jean Ann Foster, Gregory Lynn Fowler, Eugene Frank Gold, Robert Root Ireland, Jr., William Morris Keith, Jr., Donald Kissil, Robert Leslie Martin, Joel Ray McKenney, John Winston Merriott, Vaughn Clayton Moore, Gary Jan Myers, Bernard Clinton Nelson, William Thomas Northey, Philip Woodworth Ogilvie, Charlotte Elizabeth Outland, Judith Ann Rheuben, Audrey Nadine Roberts, Diana B. Schellenberg, Edward Irwin Shaw (Faculty), Ivens Aaron Siegel, Annette Templin, Emil Karl Urban, Bernard von Bockelmann, Walter B. Welch, Barbara Jean West and Joseph Zambernardi.

More members or Kappa Chapter, dated: May 7, 1956, Sidney L. Beck, Lillian Blake, Stewart N. Blumenfeld, Richard Albert Consigli, William L. Cutter, Elliot Colter

Dick (Faculty), Dale Robert Dill, Kung-chu Fan, John Ellwyn Gaddis, Paul Jay Gardner, Clarence E. Harms, Claude Eugene Hastings, Leslie Hideyasu Higa, Ella Virginia Hocker, George E. Jakway, Anita Lucille Long, Charles David Miles, Harold Dixon Murray, Ernest Gerald Pires, John L. Riggs, Thomas Santoro and Phillip Merrill Youngman.

New officers elected for the year, 1957-58 include — President, Wm. T. Northey, Bacteriology; Vice-Pres. Williard Dean, Bacteriology; Recording Secretary Jean Foster, Anatofy; Corresponding Secretary William Keith, Botany; Treasurer, Duwayne Englert, Zoology; Editor, Sydney Anderson, Zoology; Council Representative, Mrs. Ruth McNair.

LAMBDA

—Montana State University
Missoula, Montana

President: Lola Anderson, 610 University Ave., Missoula, Mont.

Vice-Pres.: Martha Lowe, Route 4, Missoula, Mont.

Cor. Sec.: Larry Blakely, 855 Beverly, Missoula, Mont.

Sec.-Treas.: Bill Mitchell, 541 E. Main, Missoula, Mont.

Council Rep.: Dr. Ludwig Browman, Zoology Dept. M.S.U.

Fac. Advisors: Dr. R. A. Diettert, Botany, M.S.U.; Dr. R. B. Brunson, Zoology, M. S.U.

(20 copies to Zoology Dept.)

Initiated 26 Feb. 1956: Robert D. Gallup, Dallard Vern Johnson, Peter Victor Leveque, Mary Meagher.

7 Feb., 1957: Gerald Joseph Backus, Dean

Lambda also inducted the following as of 7 February 1957: Gerald Joseph Backus, Dean George Biesemeyer, Harold Gene Knapp, Unda Peterson Osher, Ralph Floyd Stockstad. And followed up with the following as of 11 May, 1957: Eugene Etienne Addor, Naida Arlyn Engdahl, James Warren Gebhart, Roberta Louise Holgate, Claudia Ruth Hooper, Niles Russell Kevern, Janet Ilona Lemery, Marilyn Edith Shope, William C. Vinyard (Faculty).

Lambda's officers for 1957-58 will be: William W. Mitchell, Botany, President; Niles Kevern, Zoology, Vce-President; Eugene Addor, Botany, Sec.-Treas.; Ralph Rep., and the Faculty Advisors remain as Stockstad, Zoology, Cor. Sec. The Council before.

NU

—Washington and Jefferson College
Washington, Pa.

President: Emelio Roncace, 166 S. Wade Ave.

Vice-Pres.: Arthur Gross, 298 E. Beau St.

Sec.: Chester Handelman, 298 E. Beau St.

Treas.: Jay Jenks, 166 S. Wade Ave.

Editor: David Alter, Dorm. 2, W&JC

Fac. Adv.: Dr. C. D. Dieter

(25 copies to Dr. Dieter)

Last spring the Nu Chapter Award went to Sam G. Morosco, retiring Chapter Treasurer. In March of this year, the following were initiated on the 15th: James Randolph Birch, James Koleman Bress, Teddy Pre Vere Burger, John Peter DeCicco, Edward Thomas Deutsch, Jr., William Harold Diehl, Jr., Arnold Joel Eisenfeld, Carl Lee Fetkenhour, Robert S. Fleming, II, Henry Gelband, Robert Michael Glad, Ernest Fitch Guignon, Richard William Hirschberg, Frank Jay Keefer, John Harvey Klingensmith, Jerry Glenn Liepack, Burton Harold Pollock, Stuart Alan Rosenthal, Ronald M. Roth, Richard Cushman Saul, William Isaiah Shaw, Wilbur Homer Snodgrass, Jr., Howard Francis Stock, Martin Leslie Strassman, Donald Andrew Turcke, Harold Richard Ward and William Wayne Wood.

The 1957 Award Certificate goes to President Emilio A. Roncace.

PI

—Emory University
Emory University, Ga.

Council Rep.: Dr. W. Baker, Biology Dept.
(20 copies to Dr. Baker)

The Pi Chapter Awards last Spring went to William S. Mitchell, Jr., undergraduate, and to Daniel E. Kirk, graduate student. This year's awards are being presented to: Edward F. Menhinick, undergraduate, and to Margaret M. Wells, graduate.

The following letter to Dr. Orcutt will be of interest:

Dear Dr. Orcutt:

We have had a meeting of our Phi Sigma group to consider plans for revitalizing our local Pi Chapter for next year. I think we are going to be able to begin our activities in full blast and have a continuing active chapter during the coming years. As I have expressed to you before, I regret very much that local conditions have disrupted the activities of our chapter for the last three years but the indications are that more of our biology students will con-

tinue with us until they take their degree, which means of course we could depend upon a group of officers taking over the responsibility of the organization.

Since we do not have any of our previously elected officers on the campus, and since I am the official council representative, I have taken the responsibility of calling for a meeting to elect our delegate to the general meeting at Ann Arbor. The group was unanimous in the selection of Mr. William E. Brillhart, instructor in biology, to represent us at the meeting. We thought this action wise, since Mr. Brillhart has been very active in our local chapter during his years as a student here and since his return as instructor. In addition, as you know from conversations with him, he is most anxious to reactivate the local chapter and make its program a success.

I realize that this is not exactly in accord with the instructions which we received from the National Council, but you understand the circumstances and we feel that it is the only reasonable action we can take. I am signing the certificates as the only elected member of our local chapter. I trust this will be satisfactory.

With kindest personal regards, I am

Yours respectfully,

W. B. Baker

June 2, 1956.

RHO

—University of Illinois
Urbana, Illinois

Cor. Sec.: L. G. Swartz, Vivarium Building
Council Rep.: Prof. Norman D. Levine, 163
Vet. Building

(165 copies to L. G. Swartz)

The Rho Chapter Award certificates last January were presented to William Liddicker and Wayne H. Davis both graduate students.

On 8 May 1956 the following were inducted: Elizabeth Alden, Raymond E. Anderson, Vasant R. Bhalerao (Faculty), Rose Mary Hammer Boicourt, Louis Jefferson Boyd, Donald Richard Boyer, Eugene M. Bravi, Charles Loring Burger, Robert Jaquette Davis, Robert David Deufel, Edna Claire Dick, Frank Norris Dickinson, Elon Wilson Frampton, Louis Edward Haley, Kent Alvin Hinshaw, Leroy Jerome Hirsch, Gloria Howard, Lalitha R. Kadaba, Karl Joseph Kadlub, James Glynn Karas, Bernard Kaufman, Robert Earl Lewis.

Thomas Shui-shung Mao, Donald James Mason, William Elliot McCaul, Martha

McMillan, Krishna Nandan Mehra, Herbert M. Nakata, William Hayden Nichols, Robert Otto Novak, Robert Dale Pausch, Charles Raymond Puglia, Tara Rao, Annia Louis Richardson, Pierre Rene Rio, Willard Adams Ross, Taketami Sakuragi, Paul Henry Sammelwitz, Lyell Jay Thomas (Faculty), Joseph S. Vandemark, Gilbert Peter Waldbeuer, George Curtiss West and Harold Franklin Wilkins.

Rho inducted the following on 14 May 1957: James Joseph Albecht, Robert David Clarrk, John Clarence DeFries, Norman Arnold Dial, Margaret Pratt Dysart, Paul R. Fitzgerald, John Sylvester Hall, Virginia Ruth Ivens, Ralph Alvin Jersild, Jr., Norman DeWitt Jones, Arthur KowKatoh, Mary Emma Price, Irene Louise Rasmusen, Clyde Elliott Robbins, Larry Spurgeon Roberts, Clarence Orman Stevenson, David John Sullivan and John Winkelmann.

SIGMA

—University of Florida
Gainesville, Florida

President: Robert D. Weigel, Biology
Vice-Pres.: John R. Freeman, Biology
Cor. Sec.: Charles Haines, Animal Husbandry

Rec. Sec.: Elizabeth Schwartz, Biology
Treas.: David Caldwell, Biology
Council Rep.: Dr. James N. Layne
Fac. Adv.: Dr. James N. Layne

(75 copies to Dr. Layne)

On 19 May, 1956, Sigma Chapter inducted: Joseph Hamilton Bolick, Eugene Cleveland Bovee (Faculty), Van Tyle Burnette, Robert Franklin Gift, Frederic Wayne King, John David McCrone, John Edward Mocha, William John Riemer (Faculty), Norbert John Scully (Faculty), Alice Hedden Spieth, Martin Luther Taylor, Forrest Glenn Wood, Jr. and Arthur Gilbert Wright.

The Phi Sigma Award Certificates of 1956 went to Ann Payne Cawthorne, undergrad, and Robert Highton, graduate.

The following were accepted into Phi Sigma on 20 March this year: Jane Dorothy Beck, Carlos Humberto Blazquez, Beverly Burtis Bond, Jr., Harold Kelly Brooks, John M. Creel, Jr., James C. Dollahan, Margaret Sibert Miller, Harold Sidney Osborne, Walter Lamar Reynolds, Fred Allan Rosenberg, Eugene Bondurant Sledge, Diane Te Strake, Willie Ellen Thompson, Carl W. Trygstad and Penelope Hermes Weigel.

UPSILON

—Miami University
Oxford, Ohio

President: Jerold W. Bushong, 13-B Veteran's Village

Vice-Pres.: Don Fink

Sec.: Nancy Atkinson, 303 Hamilton Hall

Treas.: Joe L. McMahon

Editor: Paul L. McHenry

Council Rep. & Adv.: Dr. D. T. Maunder,
311 Upham Hall
(60 copies to Dr. Maunder)

Phi Sigma Awards were given to Leigh Van Valen, undergraduate, and Charles Emmanuel Buckler in the Spring of 1956. On April 12th the following were inducted: Carl F. Bell, Mary Jo Minges Bilitch, Mary Ann Jenkins, Paul Lewin McHenry, Joe L. McMahon, Barbara Pfiffner, Joanne Roehr, Grady Sarrett Jr., Lawrence McKinley Gretchen Bake VanAusdal, Evelyn Ann Sedgwick, Jr., John Edward Sherlock, Whittmann and Robert Giles Wolverton.

On 17 December 1956, the following became members: Dayanira Rosa Barnett Herrera, Earl Donald Beesley, Howard Eldon Carolus, Ida Janice Deas, Richard Merln Folden, Joan Merrivale Frey, Robert Frank Gilbert, Stephen Bennett Kelley, Constance Marie Keopke, George Frederick Leineke, Jr., Homey John Lillie, Jr., Ivan Joseph Lipman, Paul J. Pease, Marshall Perry Reich, Anne Miriam Smith, Robert Theodore Stone and James Alden Yeither.

PHI

—University of New Hampshire
Durham, New Hampshire

President: John R. Beers, Zoology

Vice-Pres.: Greta E. Tyson, Zoology

Sec.: John W. Dunn, Botany

Treas.: Burton E. Landau, Bacteriology

Council Rep.: Dr. Dorothy Travis, Zoology

Fac. Adv.: Dr. Clark Stevens, Forestry

(50 copies to John W. Dunn)

Phi chapter has had the pleasure of sponsoring several excellent programs recently. Late last Spring Col. Eugene Clark, U. S. Army retired, spoke at an open meeting about "The Natural History of the Whale." Col. Clark, of Sandwich, Mass., has made an extensive study of whales. At the first meeting this fall our program included the showing of the Disney film, "Nature's Half Acre." At our recent November meeting we were privileged to have as our speaker Dr. George Burrows who spoke on "Wildlife Conservation." Dr. Burrows, a new member of

the Zoology Department staff, presented his interesting and informative talk to a large group of candidates for election to Phi Sigma.

Inducted 11 Jan. 1956 were: Barbara J. Bailey, Biology; John R. Beers, Zoology; Robert J. Chadwick, Forestry; Patricia A. Cromwell, Bacteriology; Marilyn J. Darbe, Bacteriology; Subhash C. Datta, Botany; Joy Mary Dokos, Bacteriology; John W. Dunn, Botany; Constance M. Dyer, Botany; Patricia Gallagher, Bacteriology; Carter B. Gibbs, Forestry; Frederick Greeley (Faculty, Wildlife Management; Wilson C. Holroyd, Forestry; Mary Kay Kilgore, Biology; Burton J. Landau, Bacteriology; Herbert R. Melchior, Botany; Dewolf Merriam, Botany; William O. Merrill, Poultry Husbandry; Gennaro J. Miraglia, Bacteriology; Seward A. Ridlon, Zoology; Joseph Rosewater, Zoology; Sylvia J. Sawyer, Bacteriology; Greta E. Tyson, Zoology; and George E. Wood, Poultry Husbandry.

On 4 December of the same year, we inducted: George Howard Burrows (Faculty), Walter K. Butterfield, Carl Sheldon Campbell, Burr Clark, Jr., Joseph Brian Cushing, David Budd Dickinson, Jr., William Henry Feaster, Claude Raymond Gilmore, Maurice Edgar Goulet, Donald F. Gove, James Edward Hellen, Arnold Milton Julin, Ann E. Kammer, William Merrill, Jr., Samuel Edward Moyer, Carol Louise Nickerson, Ralph Winston Page, Ann Carpenter Paul, Sally Ann Paxman, An-susan Presby, Remo Henry Riciputi, William Barrett Rowley, Sylvia Jordan Sawyer, Thayer Cornell Shafer, Carlye Wilmer Shaw, George Peter Shibley, Shirley Lou Smith, John Edward Vanderveen and Lawrence Arden White, Jr.

CHI

—Montana State College
Bozeman, Montana

President: Mary Parker, 317 South 8th Ave., Bozeman, Mont.

Vice-Pres.: Miss Kiyoe Kotake, 1119 South 5th Ave., Bozeman, Mont.

Sec.: Marian Hookham, Quad C, Bozeman, Mont.

Treas.: Don Kenczcka, 13 A St., Bozeman, Mont.

Editor: Marion Hookham

Council Rep.: Dr. McBee, Lewis Hall, Campus, Montana State College
(50 copies to Dr. McBee)

On 1 June 1955 the chapter inducted: Jeanne Kellogg, James David Macmillan, Delano Anthony Hanzel, Robert Edward Wollitz, Beverly J. Rose, Grace Kathryn

Barber, Rita Aurelie Tureck, Laura Jean Kramar, Rafael B. Rodriguez, David Myron Near, John R. Neitz, Gerald James Krall.

On 1 Feb. 1956, the following became members: Ardis Jean Allen, Jack Norlen Armstrong, Anthony Joseph Beausoleil, Dolores Nerita Burch, Billie Marie Dulong, Elmer Bostwick Harvey (Faculty), Bruce Alan Lund, David Elliott Street, Kenneth L. Temple (Faculty), J. Richard Williams, Glenelle Wood, Giles Emery Zoller.

On 14 Dec. 1956 the roster was increased by the following: Clifford W. Hill, Edward Fredrick Weiss, Jr., Phillip Embury Griffin, David Ray Stevens, James Merrell Peek, Blanche Ernestine Fowler, Joyce Jordan Schessler, Melvin George Atwater, Lynn Lucretia Hoefert, John Hamilton Rumely (Faculty), Jack Weston Warren, Allan L. Lovaas, Ralph Allan Rouse and Leo James Middendorf.

Phi Sigma 1957 Awards went to Grace Kathryn Barber, undergrad, and Jack Weston Warren, graduate initiate.

PSI

—University of Washington
Seattle 5, Washington.

President: Royce Lockart, Microbiology

Vice-Pres.: James Kenny, Zoology

Sec.: Hilda D. Agar, Microbiology

Trea.: Ruth Portman, Obstetrics and Gynecology

Reporter: Jack Hatlen, Publ. Health and Prev. Med.

Council Rep.: Dr. Melville Hatch, Dept. of Zoology

(105 copies to Miss Hilda D. Agar)

29 May 1956 saw the induction of the following: Harry William Anderson, Jr., David Emmett Baker, Jack Franklin Behrens, Gloria E. Bratvold, Kenneth Kendall Chew, James Lowell Coatsworth, Frederick Gilbert DeHoll, William Jakob Dreyer, James C. Hampton, Jack B. Hatlen, Jr., Mary Nelle Hesselholt, Sayed Hassan Hilal, Ray Claude Johnson, George James Kenney, George William Klontz, Doris Barnes Kommers.

Eugene Vernon Lagerberg, Willard Leroy McFarland, Asse Melsom, Ramona Joyce Memmer, Clinton Wesley Morrow, Richard J. Myhre, Robert Edward Pacha, Ernest George Palola, Ruth Melba Portman, Louis William Powell, Donald Eugene Rush, David Robert Main Scott (Faculty), Elwood B. Shade, Arporna Sribhibhadh, George Stenzel (Faculty), Eyvind Thorbjornsen, Ronald Richard Tidball, Nikolaas Tinbergen (Faculty), Robert Yih-Min Ting,

Seikichi Tokuda, Ralph James Wetzel, Jr., Galeta Lois Wilson and Gary Joseph Young.

The Phi Sigma Award for 1956 went to graduate student Stanley William Strunk. On 7 June 1956 Santo Ajwani was received into membership.

Psi Chapter will be directed during the coming academic year by the following slate of officers: Neil McCormic, microbiology, President; George William Klontz, microbiology, Vice-president; Ruth Rumery, anatomy, Secretary; Joan Schmidt, surgery, Treasurer; Robert Booher, anthropology, Editor; Dr. Melville H. Hatch, zoology, Council Representative and Faculty Advisor.

OMEGA

—University of Oklahoma
Norman, Oklahoma

President: Vernon Scholes, Plant Science Dept.

Vice-Pres.: Janice Friday, Plant Science Dept.

Cor. Sec.: Don Baepler, Zoology Dept.

Rec. Sec.: Shirley Wolfenburger, Dept. of Plant Science

Treas.: Lothar Hornuff, Dept. of Zoology

Editor: Sandra Stippich, 640 Elm St.

Council Rep.: Dr. A. I. Ortenburger, Zoology Dept.

On 1 March 1956 Omega inducted: Calvin Greenwood Beames, Jr., Edward Newman Brandt, Jr., Walter Eugene Crowder, Wilbur Marvin Davis (Faculty), Clifton Roy Gravelle, Cluff Earl Hopla (Faculty), Robert Lonnie Huddleston, Robert Carl Ritter, Marilyn Verleen Rogers, Alice Claire Shiemaker, Ella Blanche Sommers (Faculty), Cullen Ashley Thaltan, Walter Winston Taylor, Dan Leroy Willson, Jack Mason Wright and Robert John Young.

The first meeting of Omega Chapter was held Sept. 25, 1956 for the purpose of electing new officers to fill those vacancies not filled last Spring. Following is a list of officers for this year:

President: John L. Zaharis, Dept. of Zoology

Vice-Pres.: Eugene Crowder, Dept. of Zoology

Cor. Sec.: Robert Elbel, Dept. of Zoology

Rec. Sec.: Marilyn Rogers, Dept. of Plant Sciences

Trea.: Lothar Hornuff, Dept. of Zoology

Fac. Spon.: Dr. Paul David

Council Rep.: Dr. A. I. Ortenburger

(60 copies to J. L. Zaharis)

All the officers elected, as well as the members present at the meeting, were

graduate students. Because of this, and other factors, I am greatly in favor of initiating new members into our chapter this Fall, in order that we may have some active, experienced undergraduate members to carry on the work of the chapter next year. We are already engaged in the investigation of potential members. We are also attempting to reactivate members who have been inactive.

Dean L. Snyder is going to speak to us Oct 22, 1956 concerning his recent stay in Hawaii.

The certificate award for outstanding work in Biol. Science for the school year 1955-56 was awarded to: Robert B. Webb, Grad. Bact. and John L. Smith, undergrad.

I will let you know how our plans work out as the year progresses. I had a very enlightening and enjoyable time in Ann Arbor, and I hope the things I learned there will have made the trip worth while both for Phi Sigma and Omega Capter.

On 2 May these were inducted: Don Colesto Ahshapanek, Will R. Blackburn, Roland Albert Cartwright, Robert George Case, Wendell Ray Casey, George Washington Counts, Raymond Dowell Couser, Ollie Wayne Dehart, Richard Anton Diener, Kenneth Jack Evans, Walter Scott Gray, Jr., Betty Gale Hooper, Fred Anderson Hooper, Jr., Clifford Leroy Meints, Ripusudan Lal Paliwal, Freddie Albert Reynolds, Robert Gale Richardson, D. Derald Smith, Eugenia Steinbach, Tien-wen Tao, James Heber Warram, Jr.

ALPHA ALPHA

—University of Southern California
Los Angeles, California

President: Marilyn Mansfield, 3924 L.A. 8
Vice-Pres.: Charles Horvath, 8649 Clifton

Way, Beverly Hills
Sec.: Sara Christensen, 1121 W. 27th St.,
L. A. 7

Trea.: Kenneth Stager, L. A. Public Museum, Exposition Park, L. A. 7

Council Rep.: Dr. William V. Mayer, Dept. of Bacteriology

Fac. Adv.: Dr. H. M. Kurtz, Dept. of Bacteriology, L. A. 7

(35 copies to Dr. H. M. Kurtz)

Inducted on 17 May 1957: Vallory Joan Besnah, Bernard B. Butterworth, William M. Hall, Jr., Charles Horvath, Beatrice Lucia Kelly, Jens Werner Knudsen, Robert E. Macfarlane, Marilyn Mansfield, Kay Grace Matly, Thomas E. Nelson, Jr., Willa Louise O'Day and Pulak Nath Sanyal.

Phi Sigma Awards last year went to: undergraduate Vallory Joan Besnah and

graduate Martha Jane Belknap.

This year's initiates on 26 April were: Patricia Anne Barton, Ved Brat, Royal Lee Brown, Isabel Mary Heinmiller, Richard Koch, Philip Irving Kramer, Kunnenkeri John Koratha, Stephen Howard Richardson and Theodore Tsuyuki.

ALPHA BETA

—Mount Union College

Alliance, Ohio

President: Donald Ahearn, Mount Union College

Vice-Pres.: Sandra Starr, Mount Union College

Sec.-Trea.: Elizabeth Koch, Mount Union College

Council Rep.: Dr. J. L. Blount, Mount Union College

(25 copies to Miss Koih)

Phi Sigma Award was presented to: undergraduate Joshua Adeniran Odetoyinbo last Spring.

Nov. 15, 1956: Ray Eugene Burrill, Shirley Beth Clark, Shirley Ann Mutschelknaus, Joseph Steven Recchi and Ronald Frank Sanner. April 10, 1957: Edward Lee Brown, Don Leon Carman, Jay Chuck, Howard David Evans, Robert Quillen Galina, David Lee Hoove, Marilyn Sue Jackson and Martha Jane Weir.

Next year's officers will be: Sandra Starr, Elliott Hall, President; David Hoover, Sigma Nu House, Vice-Pres.; Elizabeth Koch, McMaster Hall, Secretary-Treasurer. Dr. Jerry Blount is Council Representative and Faculty Advisor.

This year's Award Certificate goes to undergraduate Donald Gilbert Ahearn.

ALPHA GAMMA

—University of South Dakota
Vermillion, South Dakota

Membership in Alpha Gamma Chapter of Phi Sigma was conferred on Barry M. Brenner, as of 27 April 1957.

ALPHA EPSILON

—University of Pittsburgh
Pittsburgh 13, Pennsylvania

President: Murray A. Shellgren, 917 C.L.

University of Pittsburgh

Vice-Pres.: Marshall Steinberg

Sec.: Doris Finney

Treas.: Norbert Pietrzak

Council Rep.: Dr. Richard T. Hartman

(20 copies to Dr. Hartman)

Phi Sigma Award Certificates were con-

ferred last Spring on: William J. Pomputius, Jr., undergraduate, and Robert J. Schuellein, graduate.

The following were inducted on 12 May 1956: Monroe S. Glitzer, Ian Mitchell Sussex, Thomas J. Flanagan, Daniel Kokal, Morton Levine, James Recitous Paige, Norman Robert Farnsworth and Max Sherman.

This year's recipients of the Award Certificate are Robert Kolek, undergrad, and Gaylord E. Rough, graduate.

ALPHA ETA

—Oklahoma A. & M.
Stillwater, Oklahoma

President: Charles Basham, 619 W. 3rd St., Stillwater, Okla.

Vice-Pres.: John Beavers, Box 65, Vet Village, Stillwater, Okla.

Sec.: Jack L. Griffith, Box 182, Vet Village, Stillwater, Okla.

Treas.: Harold Powers, Veterinary Clinic, A. & M. College

Editor: Lucy Mahlstedt, 213 Willard Hall, Oklahoma A. & M. College

Council Rep.: Prof. E. R. Berousek, Dairy Dept., A. & M. College
(60 copies to Dr. E. R. Berousek)

On 4 December 1955 the following were initiated: James Norman Adams, Margie McDaniel Adams, Jack Laverne Bohl, Cloyse Glenn Cantrell, Joe Clark Christian, Buddie Curtis Hickey, Paul Durward Kennedy, Thomas Forest Yowery, John Norman Mills, Thornal Durant O'Quinn, Jr., Margie Dale Perry, Joe Neal Rogers, Harold Glen Spies, Adair Stoner and Cecil Andrew Roberts (Faculty).

On 6 May 1956, Alpha Eta initiated: West A. Clabough, Winthrop William Darlington, Bill Davis, Dixon Dale Hubbard, Kwoh Hsiong Li, Billy Joe Johnson, Margaret Carol Lippert, Jack Donavon Miller, Louis Dale Stubbs, Patricia Lou White, Warren Milton White, Joe S. Wortham, Herman Greaves Boutwell, John T. Boaz and Nancy Louise Erbar.

Award Certificates last Spring: undergraduate Jim Hasenbeck and graduate, Margaret Hoover Brooks.

Last Nov. 18th the following entered Phi Sigma at Oklahoma A. & M.: Robert Allen Boyer, Tommy James Byrd, Shirley Marion Cyrus, Kenneth Edwin Dunkelgod, O. W. Eford, Jr., Claude Gabriel Gillette, Melvin G. Greeley, James Ford Hughey, Joanne Johnson, Richard Thomas Lovell, Carol Crystal Lewis, Homer Eugene Reeves and Robert McFeters Spragg.

ALPHA IOTA

—Bucknell University
Lewisburg, Pennsylvania

President: Paul L. Crawley, Box 784

Vice-Pres.: Anna Marie Pakosky, 677 Wheatley Ave., Northumberland, Pa.

Sec.: Dorothy Richard, 28 Prospect Ave.,
Treas.: Barbara Cements, Bucknell Women's College

Editor: June Wildhack, Bucknell Women's College

Council Rep.: Dr. Roy C. Trasker, 431 Taylor Hall

(45 copies to Miss Wildhack)

New members initiated 26 May 1956 include: Nancy Louise Bimmerman, William John Carr (Faculty), Barbara Helen Clements, Paul Lewis Crawley, Joseph Carl Eberhart, Mary Elizabeth Grubb, Robert Ray Larsen, Anna Marie Pakoskey, Dorothy Ann Reichard, Carole Joan Slafkan, Norman Leonard Somerson (Faculty), Sheryl Ann Somerville and June Alberta Wildhack.

Members of Alpha Iota chapter of Phi Sigma listed in *American Men of Science*: L. P. Bly, 43 E. Main St., Cuba, N.Y.; William P. Boger, M.D., Glenhardie Rd., Wayne, Pa.; Chaeles F. Bond, 931 N. Tioga, St., Ithaca, N.Y.; Dr. William F. Elias, Paoli Rd. and Patrick Ave., West Chester, Penn.; Dr. H. Clyde Eyster, 709 High St., Yellow Springs, Ohio; William H. Eyster, Jr., 2001 Collingwood Blvd., Toledo 2, Ohio; Walter A. Freyburger, 934 Grant St., Kalamazoo, Mich.; Robert D. Griesemer, Mass. Gen'l Hosp., Boston 14, Mass.; Harold W. Heine, 304 N. 4th St., Lewisburg, Pa.

Thomas Morton Little, 5971 Deerfied Rd., Riverside, Cal.; Charles E. Mohr, Audubon Nature Center, Greenwich, Conn.; John Luther Mohr, 1208 W. 38th St., Los Angeles 37, Cal.; John W. Rice, 610 St. George St., Lewisburg, Pa.; Charles Lewis Spurr, 555 Little Lake, Bellaire, Tex.; Norman H. Stewart (deceased); Herbert A. Wenner, 9711 Johnson Drive, Merrian, Kan.

On the 12th of January the Alpha Iota chapter of Phi Sigma, here at Bucknell, celebrated its 25th Anniversary at a reunion banquet held at the Lewisburg Inn. Present were many past members who returned for the occasion.

The principal speaker was Doctor Karl Lagler of the University of Michigan, President of Phi Sigma. Doctor Lagler gave an interesting talk and showed a film concerning the Lampery Eel situation in the Great Lakes. Other speakers were

Dean Karl Hartzell, Dean of the University; Professor Emeritus Norman Stewart, who represented the charter members; and Professor Roy Tasker, our council representative.

At the banquet an initiation ceremony was performed, and three new members were added to our chapter. They are Helen Oman, Anna Kerschner and Fue Lane Wong.

At the latest count, the total number of Spring issues of the **Biologist** that will be required by our chapter is forty.

Pledged to our chapter March 4 were the following: Jan Gary Beidler, Thomas Johnston, Mary Liz Schmidt, Peggy Apgar, David Friedline, Fred Hauk, Karen Reynolds, Joan Criswell, Mary Fetter and Niles Lestrangle.

Yours truly,
June Wildhack
Editor

ALPHA KAPPA

—Hunter College
New York 21, N.Y.

President: Ceia Gordon, 695 Park Ave.
Sec.: Sonia Bajakian
Treas.: Anna D'Andrea

(30 copies to Dr. Theodora Salmon)
On 5 March 1956 the following were inducted: Clinton Andres Brown, Arline Lillian Cohen, Elizabeth Evelyn Grossmann, Shirley Kalman, Barbara Anne Hudson, Ruzene Sevcik, Melvin Lenore Silverman, Ruth Ellen Tesler.

On 14 May 1956 Alpha Kappa initiated: Gail Ann Kleinrock, Carol Sophie Brown, Joan Marie Arbolt, Libby Harriet Raphael, Donald Harold Wolmer, Paula Ellen DiSanto, Mary Strawgate Epstein (Faculty), Marcia Harriet Rankus, Ruth Mandelbaum Jonas, and on 17 December 1956 the following: Sonia Bajakian, Anna Clara D'Andrea and Celia Gordon.

The 1957 Phi Sigma Award Certificate goes to undergraduate Sonia Bajakian.

ALPHA LAMBDA

—University of Utah
Salt Lake City, Utah

President: John C. Frandsen, 203 Biology Bldg., Univ. of Utah
Vice-Pres.: Roy Speirs, 203 Biology Bldg., Univ. of Utah
Sec.-Treas.: Donald B. McDonald, 203 Biology Bldg., Univ. of Utah
Editor: Jon B. Ghiselin, 203 Biology Bldg., Univ. of Utah
Fac. Co-Advisors: William H. Behle, 1233

East 8th Ave.; George F. Edmunds, 762 Yale Ave.

(22 copies to Dr. H. Behle)

The Phi Sigma Award Certificates for 1956 went to undergraduate, Stanley A. Mulaik; and graduate, John Christian Frandsen.

ALPHA MU

—Oregon State College
Corvallis, Oregon

President: Theodore Dryness, Soils
Vice-Pres.: Theofore Barkley, Botany
Cor. Sec.: Sonya Smithson
Rec. Sec.: John Fryer, Fish and Game
Treas.: Michael Pratt, Botany
Council Rep.: Dr. Austin Pritchard, Ag. Hall

(175 copies to Dr. Pritchard)

Dr. Nathan Cohen, who has recently completed his Dissertation for the PhD degree, is now Instructor in Zoology at Modesto Junior College, Modesto, California.

Dr. Quentin D. Clarkson is on a one year appointment on the teaching staff of Portland State College, Portland, Oregon in General Biology, while Dr. Mervin Nielson is teaching at the University of Arizona.

Dr. Wes Birge has been appointed Instructor in the Zoology department of the University of Illinois and Dr. Herbert Owen is teaching at Fort Collins, Hesperus, Colorado.

In the capacity of Graduate Assistant, Brian McNab is studying at the University of California, Berkely, California.

Another item of interest is the year vacation trip of Mr. Stan Wilkes, candidate for the MS degree in Zoology at Oregon State College. He is currently enroute to India. Dr. Ivan Pratt of our Zoology department received a card from Mr. Wilkes when he was briefly staying in Egypt early in November.

The yearly lecture program of Alpha Mu Chapter was underway in the month of October with Dr. Wilson Foots who spoke on Agricultural Research and Graduate Study in Sweden.

On Nov. 29th Dr. Virgil H. Freed, Associate Chemist, Agricultural Chemistry, will speak on "Selective Toxicity as a Biological Phenomenon."

Our annual election of officers, selection of candidates and banquet will be held in March and our annual picnic in May. Dr. James Kezar of the University of Oregon will be our banquet speaker.

On the 8th of March 1956 Alpha Mu

Chapter initiated this fine class of students: Charles Ray Ades, Nancy A. Allworth, Johnnie Edgar Andre, Sukhm As-savesna, Theodore M. Barkley, Ronald Frank Batchelor, Harold Wesley Biggerstaff, Donald Stephen Black, Diana Carol Brunner, Richard Maurice Burns, Lyle David Calvin (Faculty), John Nicholas Caspar, Horace B. Cheney (Faculty), Robert Paul Chesney, David Owen Chilcote, Galen E. Clothier, Patricia Ruth Covey, David Lee Crawford, John Edward Dealy, Anne O'Connell Deeney, Max Walter de Laubenfeis (Faculty), Etta Mae Detering, John William DeWitt, Jr., Roderick Withers Dow, Richard T. Floyd, Wilson H. Foote (Faculty), Isabelle Allie May Forbusch, Kenneth Frederick Fortney.

John Lewis Fryer, Lenhart A. Gienger, Kenneth Walter Hamilton, Jr., John Herbert Hann, Donald Glen Humphrey, Walter William Jeffrey, Maurice L. Jernstedt, Norman Elden Johnson, Oliver William Johnson, Susan Johnston, Dallas Eugene Jones, Erland Theodore Juntunen, Loretta Ellen Kelley, Sigrid Klungsoyr, Shirley Kocken, Laurus Waldemar Lehwaldter, Jerome Ching Ren Li (Faculty), Clara Ju-Yuan Lin, James Aaron Linebaugh, Janet Elaine McBurney, James S. McClelland, John Elwood McCormack, Robert Burrow Melvin, James David Messersmith.

Gary Lee Messing, James Earl Miltimore, James Dawson Mohler, Otto Floyd Pahnish, Donald Eugene Pederson, Chester Allen Peek, John Rayner Pierce, Leonard William Riley, Milton George Savos, Kay Marie Season, Shirley Dale Shockley, Sonya Lynn Smithson, Hugh Palmerlee Stanley, Ivan Julius Stern, Albert Newton Steward, Russell Jackson Swett, Elisha Seujit Tikasingh, Tonks Norman Vincent, Edward John Trione, Kenneth William Twigg, Kosaku Uyeda, Ronald LeRoy Walker, Royal Anthony Wenig, Thaddeus Yarosh and Roy Alton Young (Faculty).

Alpha Mu Chapter inducted the following on March 6, 1957: Carol Anne Ager, Wood Powell Anderson, Charles Warren Arnold, Tim Bhannasiri, Stanley Nelson Brooks, Charles Henry Burrows, Jr., David LaVere Carter, George Grete Chadwick, Ard Cham-mek, Dale Edward Cooper, Hildred Mary Daly, Dawson Murray Drayton (Faculty), David Shuichi Fukuda, Annada Charan Gohain, Robert Anthony Gresbrink, Robert Morgan Hosford, Jr., Everett A. Jenne, Earl Raymond Kendle, Ellis Gilbert Knox.

Robert Frank Koontz, Harry Bert Lagerstedt, Kenneth William May, Zoltan Mutnyansky, Robert Leroy Nelson, Larry

Calmer Oglesby, James Albert Pomerening, Charles E. Poulton, Robert Louis Puyear, Kunito Sato, Antoine Hanna Sayegh, Prayul Siddhijai, William Allen Sistrunk, Ivan Harold Stice, George Uhe, Jr., and William Edward Webb.

ALPHA NU

—University of New Mexico
Albuquerque, New Mexico

President: John DeVanzo, Dept. of Biology,
Univ. of N. M.

Vice-Pres.: Edith Bratton, Dept. of Biology,
Univ. of N. M.

Cor. Sec.: Laura Coburn, Dept. of Biology,
Univ. of N. M.

Rec. Sec.: Emma Romero, Dept. of Biology,
Univ. of N. M.

Treas.: Barry Pullen, Dept. of Biology,
Univ. of N. M.

Council Rep.: Dean Edward F. Castetter,
Dept. of Biology, Univ. of N. M.
(35 copies to Dr. Castetter)

The Phi Sigma Award for 1956 went to: undergraduate, Barna Emma Romero; and graduate, John Paul DaVanzo.

On 26 April 1956 Alpha Nu initiated: Walter Edward Benny, Jr., Charles Fred Bohannon, John Walter Chisholm, Craig Semple Heffelman, Duncan Willis Martin, John C. McCormack, Jr., Richard Walter Price, Gretchen Quelle, Arthur Elihu Rosenbaum, Walter Jean Hoynton, John Maurice Tucker (Faculty) and Judith Anne Woody.

This year's Award goes to undergraduate, John S. Mohlenrich; and graduate, Jean Kautz Lauber.

ALPHA XI

—University of Rhode Island
Kingston, Rhode Island

President: Sam Margolis, Ranger Hall

Vice-Pres.: Dorothy Wujick, East Hall

Sec.: Richard Hull, Butterfield Hall

Treas.: Raymond Roberge, Sigma Chi House

Editor: Allen Hunter, Old Union

Council Rep.: Robert A. DeWolf, Ranger Hall

Fac. Adv.: Dr. Robert Lepper, Ranger Hall
(47 copies to Dr. R. Lepper)

The Phi Sigma Award Certificates for 1956 went to Grace Ann Cantanio, graduate. On 15 December the following became members of Phi Sigma in Alpha XI Chapter: John Normand Bergeron, Richard Silvan Carvalho, Pei Wen Chang, Anthony Peter Chatowsky, Daniel Anthony Cinotti,

Henry John Cook, Jr., Louis John Ferando, John Joseph Gaudet, Eugene Anthony Hagan, Clifford Frederick King, Clifford James Kosikowski, Lorraine Pauline Morin, Robert Adrian Murchiano, John Joseph Piacitelli, Leon Peter Piascik, Jr., Howard Morgan Randall, Jr. William Rivera and Wallace Edward Rogers.

This year's class, initiated on 16 April included: Harold Berkowitz, Richard James Berry, James Henry Brown, Jr., Carlo Henry Cadregari, Everett Percy Christopher (Faculty), Daniel James Faber, Bernard Ludwig Gordon, Sidney Samuel Herman, Kerwin Ellsworth Hyland, Jr., (Faculty), Micah Wei-Ming Leo, Merritt Wilson McGahan (Faculty), Donald Kenneth Phelps and Saul Bernhard Salla (Faculty).

ALPHA OMICRON

—Marquette University
Milwaukee, Wisconsin

President: Robert Korn, Biology Dept., Marquette Univ.

Vice-Pres.: Edward Frank, Biology Dept., Marquette Univ.

Cor. Sec.: Vitrude DeSpain, Biology Dept., Marquette Univ.

Rec. Sec.: Margaret Tessaro, Biology Dept., Marquette Univ.

Treas.: Ray Snyder, Biology Dept., Marquette Univ.

Editor: Patricia Wroblowski, Biology Dept., Marquette Univ.

Fac. Adv.: Dr. James Barrett, Biology Dept., Marquette Univ.

(85 copies to Rev. R. H. Reis, S.J.)

On 24 April 1956 Alpha Omicron Chapter inducted: Peter Abramoff (Faculty), Harry Chinninian, Louis Salvatore D'Aquila, Dolores Langsa Dizon, Phyllis Anastasia Galasinski, La Pearl Hamilton, Robert Louis Henquinet, Barbara Ann Herbes, Rosalie Therese Herr, Joseph Philip LoBue, Daniel Paul Marasco, Eve Carol Rudich, Helen Margaret Sullivan and Daniel Gabriel Szollosi.

This year's class, initiated on 24 March 1957 were: Gretchen E. Bartenbach, John Casimir Cajski, Anthony Joseph Carcieri, Anneliese Margaret Cegler, Katherine Teresina Connor, Carion David, Russell Adland Eisenberg, Nicholas Archie Esser, Stanley Ralph Gawlik, William Theodore Gnewuch, Robert Edward Hoene, Peggy Joan Pula, Leonard Edward Rambow, Raymond Felix Skrentny, Jr., Paul J. Smith and Marion Xavier.

Next year's officers of Alpha Omicron Chapter will be: Anthony Carcieri, presi-

dent; Katherine Connor, Vice-Pres.; Anneliese Cegler, Rec.-Sec.; Sister Marion Xavier Cor.-Sec.; Sister Marion David, Treas.; Stanley Gawlik, Editor; Rev. Raymond H. Reis, S.J., Council Rep.

ALPHA PI

—University of Colorado
Boulder, Colorado

President: Robert P. Higgins, 2404 Water C. Boulder, Colo.

Vice-Pres.: Deborah Ann Merrill, 1025 15th, Boulder, Colo.

Sec.: Alvin M. Earle, 990 14th, Boulder, Colo.

Treas.: Oakleigh Thorne II, 1201 Balsom, Boulder, Colo.

Editor: Kathryn Obergfell

Council Rep.: Dr. Charles H. Norris, Assoc. Prof. Biol., Dept. of Biology, University of Colorado

(57 copies to Dr. C. H. Norris)

Initiated 17 April 1956: Tom Charles De Berry, William Droegemueller, Jean Carole McBride, Barbara Louise Ruffe, Paul W. Winston (Faculty), David S. Love.

On Dec. 11, 1956 the following were inducted: Raymond Joseph Betson, Bill Morgan Boland, Ruth Anne Crissey, Winifred Dickinson, Joyce Gellhorn Greene, Dyke Kanai, Margaret Powers and Donald Jerry Komma.

Received into membership on 10 April 1957: Douglas Gordon Alexander, Robert Webster Barnes, Donald Howard Bates, Edward W. Berg, John Trent Browne, Harold A. Cahn, Ronald Anthony Cox, Lawrence David Crowley, Carmen Rita Hill, Eugenia Marie Jern, Thomas Carrol Moore, James Harvey Nelson, Roy Ota, Eugene Herman Schmitz, Nancy Louise Simms and Robert Duncan Sutherland.

ALPHA RHO

—University of Arkansas
Fayetteville, Arkansas

President: Glen J. Dixon, Dept. of Botany and Bacteriology

Vice-Pres.: Billy G. Diggs

Cor. Sec.: John R. Bagby

Rec. Sec.:

Treas.: Shelby M. Smith

Council Rep.: Dr. Delbert Swartz, Dept. of Botany and Bacteriology

(28 copies to Dr. Swartz)

Alpha Rho initiated the following on 26 March 1957: Betsy Lloyd Berry, Louis Joseph Carbone, Tsueng-Hsing Chang, John James De Costa, Lyles Ray Delaney, James

Wilson Duke, William Frank Evans, Samuel Louis Finkelstein, Daude Newton Griffin, Virginia Fay Green, Douglas Brewer Jester, Forrest Eugene Lane, Kenneth Dean Mace, Grace Margaret Page, Dewey Lee Tackett, Myra May Trapp, Jerry Dean Trenary and Jacob L. Golding.

ALPHA UPSILON

—University of California at Los Angeles
Los Angeles 24, California

Council Rep.: Dr. Bernard O. Phinney,
Dept. of Botany
(5 copies to Dr. Phinney)

The Sigma Award Certificates for 1956 went to: Undergraduate: John Deelman, and Graduate: John J. Holland.

ALPHA PHI

—College of Puget Sound
Tacoma, Washington

President: Kirk Springer
Vice-Pres.: Ruth Arnold
Cor. Sec.: Virginia Luckey
Rec. Sec.: Juris Macs
Treas.: Don Dudley

Council Rep.: Dr. Gordon D. Alcorn, Biology
Dept., College of Puget Sound
(20 copies to Dr. G. D. Alcorn)

On 17 May 1956 the following were initiated: John Gerald Girard, Kirk William Springer.

The 1956 Award went to: Undergraduate: Ruth H. Arnold.

At 12 February 1957 the following became active: Patricia Margaret Cann, Karen Mary Croteau, Joan Darlene Carlson, Sonja Koehler, Charles Robert McGill, Virginia Jane Sangesand and Janet Marie Timmons.

ALPHA CHI

—University of the Philippines
Quezon City, Philippines

President: Miss Magdalena Cantoria, College of Pharmacy, U.P., Quezon City
Vice-Pres.: Dr. Bayani S. Santos, College of Veterinary Medicine, U.P., Quezon City
Cor. Sec.: Dr. Juan E. Quejada, College of Dentistry, U. P., Manila
Rec. Sec.: Miss Nieva E. Veloira, Dept. of Botany, College of Liberal Arts, U. P., Quezon City

Treas.: Mrs. Michal Manayan, Dept. of Zoology, College of Liberal Arts, U. P., Quezon City

Editor: Mrs. Paz R. Angeles-Puruganan, 34 Mayon St., Quezon City

Council Rep.: Dr. Gregorio T. Velasquez, Dept. of Botany, College of Liberal Arts, U. P., Juezon City

Advisers: Dr. Gregorio T. Velasquez (Address as above)

Dr. Amado T. Feliciano, Dept. of Zoology, College of Liberal Arts, U. P., Quezon City

(225 copies to Dr. Juan E. Quejada)

into Phi Sigma membership: Gregoria Ti-

On 18 March Alpha Chi Chapter received anco Banzon, Felicidad Mendoza Bautista. Veronica Fernandez Chan, Martin S. Celino (faculty), Lorna E. Purisima-Estrada, Bernardo Panualcarnal Gabriel, Araceli Basan Gonzales, Araceli Felices Lachica, Katherine Lim, Patrocinio Penyaranda Makabenta, Josephine Jimenez Marquez-Malixi (faculty), Emma Rosario Nalupta, Jean Aurelio Nicolas, Emiliana Sierra Novero, Dolores Altoveros Ramirez, Alejandro C. Reyes (faculty), Tito Juralbal Rimando, Mercedes Bonifacio Valero, Mariano G. Yagore, Jr. (faculty), Romeo Morales Zarco (faculty).

Phi Sigma Award Certificates presented by Dr. Vidal A. Tan, President of the University, went to: Undergraduate: Dolores A. Ramirez, and Graduate: Felicissima C. Garcia.

The following were inducted into Phi Sigma by Alpha Chi on 12 March 1957: Daniel Campo Abellana, Eloida M. Angeles, Laureano Ocampo Bondoc, Benjamin David Cabrera, Teodoro Garcia Cadiz, Maria Factora Caluya, Lourdes R. Espiritu-Campos, Chong Chian Chuang, Victoria Mendiola Ela, Marcelino Reyes Fojas, Jr., Rollo Kasumpang De La Fuente, Benjamin Cervantes Gabriel, Nora Tandiana Ignacio, Antonio Velasco Jaclna, Pedro Gangoso Padlan, Arturo Cruz Reyes, Mario Oiba San Juan, Ibarra Santos Santos, Donnelita Mesina Viardo, Violeta Garcia Viola and James K. Y. Yao.

Awards for this year go to: Undergraduate, Alfredo T. Ramirez; and Graduate, Adoracion Tibayan-Aranyez.

ALPHA PSI

—Virginia Polytechnic Institute
Blacksburg, Virginia

President: Herbert G. Windmueller, Box 6226, Va. Tech. Sta.

Vice-Pres.: Frank S. Walker, Jr., Box 6216, Va. Tech. Sta.

Sec.: Evanne V. Loh, Box 4578, Va. Tech. Sta.

Treas.: Roderick W. Young, Smyth Hall

Editor: Sam F. Rickard, Box 5405, Va. Tech. Sta.

Council Rep.: Dr. R. W. Engel, Smyth Hall
Chap. Adv.: Dr. J. D. Pendleton, Smyth Hall

(75 copies to Sam F. Rickard)

On 19 May 1955 Alpha Psi inducted

James Rowell Rooney 2nd, and William Reid Williams 3rd. On 17 November of 1955 the following were inducted: Richard Henry Lee Chichester III, Maggie Ru-chih Chow, Richard Howell East, Gerald Hugh Elkan, George Vernon Frankhouser Jr., Herman William Gabriel III, Pien-chien Huang, Evanne Van Loh, Charles Francis McDermott, Samuel Ford Rickard, Frank Stringfellow Walker Jr.

On 14 May 1956 the Chapter was further augmented by: Clemens John Ackerman (faculty), Contee Lynn Adams, Jr., William Edward Eccleston, Robert Hayes Giles, Jr., James Henry King, Jr., Burd Sheidon McGinnes, Allen Raymond Stickley, Jr., Maurice Baskerville Tanner and Edwin Leon Williams II.

On 28 November Alpha Psi inducted: Cecil Rucker Brooks, Richard Lawrence Hoffman, Pa Ho Hsu, Allen Huff Rakes, Sara Lee Richardson, David William Robinson, Frank Bryan Strader, Jr., Jean Gibson Swartz, Jack Grossman Taylor, Charles William Thomas.

The 1956 Phi Sigma Award Certificates went to undergraduate Charles L. Hanson and graduate Herbert G. Windmueller. On April 17 of this current year the following were initiated: James Diggs Ashley, Thomas Lynn Bibb, Chen Kuo Chun, Robert Allen Dameron, Jr., Robert Nicholas Davis, Clyde Straley Givens, Jr., William Roger Greear, Jerry Brown Hardigree, Richard William Hartmann, Lunsford Dale Higginbotham, William Lee Hiner, Robert Lee Hodges, Margaret Marshall Holland, Jackson Eugene Jeffery, Richard Leroy Keithley, Henry Lewis Marks, Caddy Rowan Meekins, Cloyd Crockett Morris, Jr., Jack Huff Newman, Barbara Sue Orcutt, Donald Earle Othoson, John Henry Reeves, Jr., Coleman Younger Ward and Charles Bruce Yates, Jr.

ALPHA OMEGA

—University of Georgia
Athens, Georgia

President: Miss Guthrie Talbert

Vice-Pres.: Russell Lindsey

Sec.: Alton Ewing

Treas.: Ralph Poe

Editor: Sarah Ann Staples

Council Rep.: Dr. E. E. Byrd

Fac. Advisor: Dr. J. J. Westfall

(70 copies to Miss G. Talbert)

On 25 April 1956 Alpha Omega Chapter inducted into Phi Sigma: Beverly Venner Benton, William Joseph Benton, Larry Derl Caldwell, Matthew Page Mackay-Smith, Ezra Montanye Marshall, Elizabeth Jane Nuttycombe, Andrew S. Rogowski, Frode Ulvcdal, William Aubrey Webb, Frederick

Horace Whittaker, Elizabeth Dell Young and Joseph Frederick Symons, Jr.

The 1956 Phi Sigma Award Certificates were presented to undergraduate Birch Lee McMurray, and graduate Daniel J. Nelson.

In January of this year, on the 15th to be exact, the following were inducted: Edwin Howard Blackburn, Herbert Gaffney Blalock, Jean Schmidt Bowen, Charles Maxwell Bruce, V. Otho Cline, Jr., Julian Wright Crews, Charles Boyd Elkins, Jr., Charles Bennett England, Samuel Melvin Goodrich, Allen Charles Hankins, William Lewis Hanson, Jo-Allene Horne, William Perry Joiner, F. Leslie Long, Robert Sidney Lowrey, Jr., William Albert Morris, Roslyn Seligman, Emmett Booker Shotts, Jr., Harvey Grover Spears, Jr., Robert Eugene Tanner, Wallace Armell Tarpley, Ezekiel Frel Thomas, Jr., Frank Harry Thomas, Linton Burnside West, Jr., Thomas Kelley White, Jr., Maung Htein Win, William Glenn Young.

On the first of May, Alpha Omega Chapter inducted Dr. Julian Howell Miller, Head of the Department of Plant Pathology and Plant Breeding at the University of Georgia, to honorary membership in Phi Sigma.

Members of Alpha Omega Chapter who are listed in "American Men of Science" include: E. J. Beck, E. E. Byrd, Donald Cooperrider, A. A. Fleming, J. W. Foster, Martin Frobisher, C. W. Hinton, J. H. Jenkins, A. I. Kleckner, H. O. Lund, R. B. McGhee, J. W. Nuttycomb, G. L. Plummer, V. B. Robinson, H. W. Schoenborn, W. P. Van Eseltine, J. J. Westfall. Affiliated with Alpha Omega Chapter, but with original membership elsewhere are: C. E. Hamilton (Rho), Bernard Martof (Beta), E. P. Odum (Rho), J. J. Paul (Zeta).

On the first of the current month Alpha Omega inducted: George Foster Armstrong, Jr., Olive Kendrick Britt, James Ira Casey, Jr., James Robert Duncan, L. Jane Hillegas, Rudolph Edward Howell, James Malcolm Kling, James Harris Lewis, John Charles Lucchesi, Jerome Herman Maner, Gene Earl Michaels, Clifford Newell Nolan, Julia Carolyn Poole, Dale Vernon Sweet (faculty), and Thomas Edwin Todd.

The affairs of Alpha Omega will be guided during the next scholastic year by these officers: Fontelle Thompson, Milledge Hall, president; Clyde Connell, R. 2, Athens, vice-president; Andrew Rogowski, 1344 So. Lumpkin St., Athens, secretary; Glenn Young, Box 254, Ag. Hill, treasurer; Edwin Blackburn, 437 Bloomfield, Athens, editor; Dr. E. E. Byrd, 580 Milledge Circle, Athens, council representative; and Dr. C. W. Hinton, 178 Rutherford, Athens, faculty advisor.

BETA ALPHA

—Pennsylvania State University
State College, Pa.

President: Robert C. Dalzell
Vice-Pres.: Jacqueline M. O'Dell
Sec.: Darlene M. Rumbaugh
Treas.: William Henry Kelton
Editor: Harold Franklin Little
Council Rep.: Dr. H. W. Frings
(50 copies to Mary Ann Joiner, Zoology Dept.)

On April 20, 1956 the following new members were inducted into Beta Alpha Chapter: Lester Bubbs Bower, Jr., George Robert Bubash (faculty), Paul J. Glantz (faculty), Jacqueline Mignon O'Dell, Hayes Todd Pfitzenmeyer, Jr., Darlene Myrna Rumbaugh and Barbara Ann Voysey.

BETA BETA

—Florida State University
Tallahassee, Florida

President: Neil Hulings, Oceanography
Vice-Pres.: Donald Dery, Zoology
Sec.: Miss Bertie Pittman, Bacteriology
Treas.: Richard C. Jackson, Physiology
Editor: Joan Hassett, Physiology
Council Rep.: Dr. Dexter Eaton
Fac. Adv.: Dr. Grace C. Madden
(40 copies to Dr. Madden)

Charter members at the installation of Beta Beta Chapter at Florida State Uni-

versity on 18 February 1956 were: Ronald Carl Phillips, James Milton Thomas, Joan Dorothy Hassett, Morris Talmage Suggs, Jr., Luis Raul Almodovar, James Santiago Cockcroft, Donald William Dery, Sidney W. Fox (faculty), Robert Kenneth Godfrey (faculty), George Daniel Grice, Jr., Clarence Wenford Hardiman, Gilbert C. Hughes III, Neil Carlton Hulings, Richard Thomas Jackson, Mary Ann Joyner, Robert Kral, Harry Joel Lipner (faculty), Robert Thomas Lynn, Robert Winston Menzel (faculty), Mohssen Shokouhi Nejad, Fred Eugene Nichy, Chester S. Nielsen (faculty), Bertie Pittman, Bonny Clifton Townsend, Jr., Lovett Edward Williams, Jr. and Arthur William Ziegler (faculty).

Sylvia Alice Earle was inducted into the new chapter on 1 May 1956.

The first Phi Sigma Award Certificates to be bestowed on the Florida State Campus went to undergraduate Mary Ann Joyner, and to graduate student William D. Reese.

Beta Beta inducted its first class of initiates on 29 March 1957. Among them were: John Patrick Adams, Jayne Carolyn Allen, Elisabeth Colvin Beck, George Ernest Bennett, Martha Barden Bradley, Joseph Morhart Branham, Sterling Gene Clawson, Rhodes Burns Holliman, Dwight Wilson Lambe, Jr., Mary Clare Langan, Sally Lexow Megraw, Gary Walter Nahrstedt, John James Stuehling, Jr., Alvin Wagner, Ann Wall, and Kamal Salman Yackzan.

All Phi Sigma Welcomes Beta Gamma Chapter

BETA GAMMA

—Long Island University
Brooklyn, New York

President: Ronald Cohen
Vice-Pres.: George Valentino
Cor. Sec.: Fred Katz
Rec. Sec.: Leonard Popowitz
Treas.: Richard Arnold
Editor: Joseph Oginski
Council Rep.: Dr. John C. Baiardi
(30 copies to Joseph Oginski)

Under the guidance of a Chapter Establishment Committee composed of students Arnold, Cohen, Greco, Oginski, Valentino and Venturelli, the former "Anaphy" petitioned Phi Sigma for entrance as Beta Gamma Chapter. A rousing welcome came from the Chapters. Beta Gamma was formally installed by Drs. Lagler and Orcutt on 27 April. Faculty and Charter Members

are recorded as follows:

Faculty Members: Dr. John C. Baiardi, Dr. Samuel Bieber, Dr. Jasper C. Maruzzella, Dr. Norman V. Rothwell, Dr. Joseph Schiller, Dr. Charles Tanzer, Dr. Edgar A. Tonina, Dr. Daniel Widelock, Dr. Phoon T. Young, Prof. Anthony J. Iovino and Mr. Domenic Firriolo.

Charter Members: Richard H. Arnold, Margaret J. Barbera, Philip S. Cifarelli, Ronald E. Cohen, Joseph J. Giglio, Kenneth M. Goodman, Joseph A. Greco, Arthur D. Herold, Fred M. Kahn, Fred H. Katz, Joseph F. Norato, Joseph R. Oginski, Leonard Popowitz, Emma L. Quinones, George P. Valentino, Stella G. Venturelli, Richard Weiner and Stanley S. Weinreb.

Program

Invocation — Dean Mildred L. B. de Bar-

ritt, Dean of Women and Director of Student Activities
 Introduction of Guests and Confirmation of Officers — Ronald E. Cohen, President
 Welcome Address — Dr. Jacob I. Hartstein, Dean of Graduate School
 Inauguration of Chapter — Dr. Karl F. Lagler
 Officers and Presentation of Charter — Dr. Fred S. Orcutt
 Acceptance of Charter in behalf of Administration of the University — Dr. Jacob I. Hartstein
 Biology Department — Dr. John C. Baiardi, Chairman of Biology Department
 Student Government Association — Malcolm Berenson, Member of Student Council and President of Junior Class
 Beta Gamma Chapter — Richard Arnold, Treasurer

Address, "Aims and Ideals of Phi Sigma Society" — Dr. Karl F. Lagler
 Address, "What Does Biology Hold for the Future Benefit of Mankind" — Dr. Bernard J. Ficarra, M. D., K. S. G., Director of Surgery, Roslyn Park Hospital
 Dr. Ficarra's address was built around the proposition that although mastery in any segment of biology requires great diligence and application, it still remains that no biologist can realize much from his efforts that will benefit mankind unless he is truly humble. This is especially true since the potential benefits for man's future may be greater from biology than from any other science.

Dr. John Biardi, Council Representative and Faculty Advisor, came in for repeated tributes on the program because of his fine leadership and helpful spirits.

NEW BOOKS

This section offers brief, mostly uncritical reports on the general content of recent publications in biological and related fields. Only the longer critical reviews will be signed. Each notice will be preceded, wherever possible, by the L. C. card number, for the convenience of Librarians.

Rudolf Virchow, by Erwin H. Ackerknecht; University of Wis. Press, 811 State St., Madison, Wis. 1953. 304 pp., 3 illus. \$5.00

Much-needed definitive study of Virchow's life, sympathetically handled by a fellow Pomeranian on the University of Wisconsin Medical School Faculty.

Bird and Butterfly Mysteries, by Bernard Acworth; Philosophical Library, 15 E. 40th St., N. Y. 16. 1956. 297 pp., illus. 11 figs. \$7.50

Tripartite treatment of Bird Migration Phenomena, the Cuckoo Mystery, and Butterfly Migration, which advances new theories and bids fair to substantiate them.

Land, Water and Food, by Herbert Addison; Essential Books, Inc., 16-00 Pollitt Drive, Fair Lawn, N. J. 248 pp., 36 figs. \$2.90.

Objective study of man's achievements in water control as far as it has gone, stressing the land and water aspects, with good diagrammatic text-figures.

Propagation of Horticultural Plants, 2nd Ed., by G. W. Adriance and F. R. Brison; McGraw-Hill Book Co., Inc., 330 West 42nd St., N. Y. 36. 1956. 298 pp. \$6.50

54-12243

Second edition of original useful work published 16 years ago, brought up-to-date and a mighty handy book to have on the applied botany shelf.

Forage Crops, by Gilbert H. Ahlgren; McGraw-Hill Book Co., Inc., 330 West 42nd St., N. Y. 36. 1956. 536 pp., illus. \$7.00

55-11922

Second edition of text which covers legumes and grasses as forage, their seeding and production, with considerations on prob-

lems and future prospects

General Biology, by Gordon Alexander; Thomas Y. Crowell Co., 432 Fourth Ave., N. Y. 16. 1956. 881 pp., illus. \$6.75

56-7457

Twenty years of teaching experience boiled down into a year-length course which is comprehensive but not tedious, yet includes ecology as a division of biology, and does not neglect taxonomy, distribution and conservation.

Rain Forests of Golfo Dulce, by Paul H. Allen; University of Florida Press, Gainesville, Fla. 1956. 417 pp., 34 pls., 22 figs. \$8.50

56-9482

The Golfo Dulce lies on the Pacific side of the Isthmus of Panama, a little west of the Canal, which assures its banks of almost 200 inches of rainfall each year, thus accounting for the luxuriance of the growth of the plants, shrubs and trees figured and described here.

Carnations for Everyman, by Montague C. Allwood; Charles T. Branford Co., 69 Union St. Newton Center 59. Mass. 1953. 143 pp., 56 figs. \$2.50

Fourth edition of an English work, lovingly written by the originator of many new strains of "The Divine Flowers" the carnations, pinks and dianthus.

Medical Research, a Midcentury Survey, by The American Foundation; Little Brown & Co., 34 Beacon St., Boston 6, Mass. 1952. 2 vols. 765 & 740 pp. \$15.00

55-11815

Fourteen anonymous papers on medical advances piled up in a staggering mass, a 40-page bibliography, but no index!

Plants of the Bible, by A. W. Anderson; Philosophical Library, 15 E. 40th St., N. Y.

16. 1957. 72 pp., 12 pls. in col. \$6.00

Not strictly scientific, — you will look in vain for an identifier's initials after any one of the Latin names, — but the maintainance of antiquarian interest by using 19th century color plates helps.

Diseases of Fruit Crops, by Harry W. Anderson; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 501 pp., 94 figs. \$8.50

55-11923

Each common disease broken down into discussions of its history and distribution, symptoms, economic importance, causal organism, disease cycle, environmental relations, pathological history and control.

Soil Conservation, by Sellers G. Archer; University of Oklahoma Press, Norman, Okla. 1956. 305 pp., 5 tabs., 14 figs., 30 ill. \$3.75

56-6002

From his own experience in working with farmers, ranchers and landowners, this U.S. Soil Conservation specialist presents much needed information which will help them take advantage of services available, and eliminate confusing or exaggerated misinformation concerning conservation.

Techniques of Radiobiochemistry, by Sam Aronoff; Iowa State College Press, Press Bldg., Ames, Iowa. 1956. 228 pp., 14 figs., others. \$7.95

56-7374

Spiral-bound lab manual for biochemists using radioisotopes who wish to know underlying theories and principles, and to study more common compounds used.

Connective Tissue in Health and Disease, ed. by G. Asboe-Hansen; Philosophical Library, Inc., 15 E. 40th St., N. Y. 16. 1957. 321 pp., ill. \$15.00

Twenty-three specialists, many of them pathologists, from all over the world, contribute their tessera to this work of utmost importance to the medical world, which for too long has been more interested in other less-important objectives.

Introduction to Cybernetics, by W. Ross Ashby; John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16. 1956. 295 pp., figs. \$6.50

"The basic ideas of cybernetics can be treated without reference to electronics, and they are fundamentally simple; so although advanced techniques may be necessary for advanced applications, a great deal can be done, especially in the biological sciences, by use of quite simple techniques, provided they are used with a clear and deep understanding of the principles involved." (Author).

Magic, Myth and Medicine, by D. T. Atkinson; World Publishing Co., 2231 West 110th St., Cleveland 2, Ohio. 1956. 319 pp. \$5.00

56-5306

The story of the innovators who, out of ancient superstitions have worked the scientific transformations that are the means of saving lives. Topical, rather than inclusive. Beaumont gets some credit that might have gone to Spallanzani, who performed on himself some of the experiments that Beaumont worked in Alexis St. Martin's open stomach.

Genetics in the Atomic Age, by C. Auerbach; Essential Books, 16-00 Pollitt Drive, Fair Lawn, N. J. 1956. 106 pp., 46 figs. \$2.00

Pocket-sized and popularly written as well as illustrated, this little volume expresses the author's belief that it is possible to explain the essentials of genetics in words of every-day life without the use of checker-board diagrams and Mendelian ratios.

About Mice and Man, by Frederick R. Avis; J. Weston Walch, Box 1075, Portland, Maine, Publisher. 1956. 192 pp. \$3.00

Paper-covered high-school lab manual designed to interest students in biological research techniques by putting them through a rather intensive course in mouse anatomy.

Color Guide to Tropical Fish, ed. by H. R. Axelrod and W. Vorderwinkler; Sterling Publishing Co., 215 East 37th St., N. Y. 16. 1955. 160 pp., ill. \$3.95

55-10379

How to identify your tropical fish by external features and colors in 160 pages.

Handbook of Tropical Aquarium Fishes, by H. R. Axelrod and L. P. Schulz; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 718 pp., 600 ill., 180 in color. \$10.00

54-8817

198 genera described and discussed, with something about the ecology and behavior of each, together with a good chapter on fish diseases by Van Duijn Jr.

Agricultural Ecology, by Girolamo Azzi; Essential Books, 16-00 Pollitt Drive, Fair Lawn, N. J. 1956. 424 pp., 47 figs. \$7.20

The author of this rather unusual book defines agricultural ecology as the study of the physical characteristics of the environment, climate and soil, in relation to the development of agricultural plants, and to the yield of such plants from the quantitative, qualitative and generative points of view, — and apparently has been able to achieve his objective of "harmonically" incorporating into it the policies of Brounov, Gassner, Lysenko and Vavilov.

Science in Progress, Volume IX, ed. by George A. Baitsell; Yale University Press, New Haven, Conn. 1955. 343 pp., 153 figs. \$6.50

39-14778

This is the ninth volume in the series of Sigma XI National Lectures, and contains important papers by Laurence Snyder, Curt Stern, E. J. Kraus, Kenneth V. Thimann, George Wald, Lee E. Farr, Felix Bloch, William Shockley, D. B. Steinman, and Wallace R. Brode.

Symposium on the Permeability of Soils, ed. by E. S. Barber; American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 1955. 186 pp., figs. \$3.00

Ten papers and an introduction by eleven of the leaders in this country's soil studies make up this Special Technical Publication No. 163.

Common Exotic Trees of South Florida, by Mary F. Barrett; University of Florida Press, Gainesville, Fla. 1956. 414 pp., 178 figs. \$8.50

56-9481

Scientific guide-book to aid the interested traveller in the recognition of the foreign dicots among 1st tree population, including not only leaf diagrams of the more difficult forms, but also a five-page guide to street and house numbers where specially interesting forms may be seen.

The Tree Expert, by F. A. Bantlett; Research Publishing Co., P. O. Box 245, Boston 1, Mass. 1956. 32 pp. \$1.00

This booklet by the head of one of the nation's reputable tree maintenance organizations is No. 11 in a series of 11 occupation monographs, which aim to guide students into satisfying fields of endeavor as their life work.

Laboratory Syllabus for General Zoology, by D. Elden Bech; Burgess Publishing Co., 426 South Sixth Street, Minneapolis 15, Minn. 1956. 293 pp., 91 figs. \$.00

Praise the Lord, and look at all the ammunition! Here is an author-teacher who believes in starting with simple things like protozoa (if any one could call them really simple) and works his students all the way through the increasing complexities of the evolutionary scale up to the frog,—and he doesn't jump all over the phylogenetic tree like a scared jackrabbit.

Illustrated Manual for Principles of Biology I, by W. H. Behle, L. T. Nielson and G. T. Edmunds; Burgess Publishing Co., 426 South Sixth St., Minneapolis 15, Minn. 1956. 51 pp. \$1.50

Apparently the authors of this manual weren't intellectually or administratively tethered in their search for un-hackneyed experimental materials,—all of which should make this book refreshingly stimulating.

Early American Science Needs and Opportunities for Study, by Whitfield J. Bell; Institute of Early American History and Culture, Box 1298, Williamsburg, Va. 1955. 85 pp. \$1.25

If this book's title were fed into an electronic brain which could punctuate, it would be interesting to see how many different meanings could be gotten out of it,—but, from the fact that over half the MSS is bibliography, one gathers that there is plenty of room for lots of science historians to get busy right here at home in the U.S.A.

The Origin of Vertebrates, by N. J. Berrill; Oxford University Press, 114 Fifth Ave., N. Y. 11. 1955. 257 pp. \$4.00

Eight chapters on the ascidians, three on pelagic tunicates, three on amphioxus, and three on the vertebrates, with five side trips thrown in, make up the time table for which the eminent professor of zoology at McGill University is the conductor,—and all of it over little travelled terrain.

The Human Body, Its Anatomy and Physiology, by C. H. Best and N. B. Taylor; Henry Holt and Company, N. Y. 1956. 723 pp., ill.

Described by one of its authors as a new book with a few parts taken from its predecessors, this third edition adopts the latest anatomical terminologies, with the result that the glossary is entirely new, and the physiological portions have been mostly rewritten.

Cytology and Life History of the Bacteria, by K. A. Bisset; Williams and Wilkins Co., Guilford & Mt. Royal Sts. Baltimore, Md. 1955. 164 pp., 68 figs. \$6.00

This is a "must" book for all biology libraries although botanists may disagree

with the author's cogent arguments for the origin of primitive bacteria from the flagellated protista, probably through the spirillas,—which if true would give zoologists a thoroughly disreputable phylum in their own closets, and leave the botanists the fungal phylum as their family skeleton.

Medicinal Chemistry (Vols. 2 and 3), ed. by F. F. Blicke, C. M. Suter and R. H. Cox; John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16. 1956. Vol. 2, 311 pp., \$10.00. Vol. 3, 346 pp., \$10.50

Chemists and pharmacological research workers should find helpful the articles on cardiac glycosides, synthetic estrogens, arylpiperidine derivatives, Beta-haloethylamine adrenergic blocking agents, in the first volume and methadone, quaternary ammonium germicides non-mercurial diuretics and the synthetic analogs of physostigmine in the second.

Great Migrations, by Georges Blond; The Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 192 pp., \$4.00

Dramatic even in its translation from the French, this book tells the popular story of migrating Chinese geese, the golden plover, herring, smelt, eels, buffalo, wingless locusts and the lemming. 56-11445

Euphausiaceae of the North Pacific, by B. P. Boden, M. W. Johnson and E. Brinton; Univ. of California Press, Berkeley 4, Calif. 112 pp., 55 figs. \$1.50

This paper from the Scripps Institution of Oceanography covers the tiny shrimp of the Pacific commonly known as "krill", which are a substantial source of food for the herring and the sardines of our western waters.

Biochemistry and Physiology of Bone, ed. by G. H. Bourne; Academic Press, 111 Fifth Ave., N. Y. 3. 1956. 875 pp., ill. \$20.00

First one-volume work to gather the results of all kinds of research on bone as living tissue which up to now were scattered in periodicals devoted to medical science, biochemistry, biophysics, physiology and anatomy.

International Review of Cytology, ed. by G. H. Bourne and J. F. Danielli; Academic Press, 111 Fifth Ave., N. Y. 3

Volume 4, 1955: 419 pp., figs. and pl., \$9.00, has articles on cytochemical micrurgy, amoebocyte fixation problems, plant mitochondria, chloroplast structure, nucleic acids, nucleoli, goblet cells, cholinesterases, and active transport of cations.

Volume 5, 1956: 570 pp., figs. and tabs., \$11.50, has articles on labeled antibodies in histochemistry, bacterial cell walls, enzyme adaptations, cytochondria, neuron mitochondria, nuclear deoxyribonucleic acid, protoplasmic contractility, intracellular pH, red cell enzymes, macromolecular uptake and transfer, pancreatic and salivary secretion, acrosome reactions, spermatogenic cytology, and electron revelations in cell ultrastructure.

Cone-Bearing Trees of the Pacific Coast, by N. A. Bowers; Pacific Books, Publishers, Palo Alto, Calif. 1956. 169 pp., ill. \$3.50

In addition to identification keys by geographical areas, elevations, and needles, there is a new chapter in this fifth reprint. 56-9436

ing on dendrochronology, tree-ring analysis.

Louis Agassiz Fuertes, by Mary Fuertes Boynton; Oxford University Press, 114 Fifth Ave., N. Y. 11. 1956. 317 pp., illa. \$7.50
56-5705

Mostly his correspondence, edited by his daughter, is presented here as the best evidence of the many talents of the man who has been called the world's greatest bird painter.

Humorous Introductions, by L. M. Brings; T. S. Denison Co., Minneapolis, Minn. 401 pp. \$4.50
55-11067

Every one of our readers has perhaps had to make a speech at some time or other, or to have been introduced by a speaker, or to be the introducer of another speaker, and, undoubtedly, more than once had occasion to wish that the other party knew how to be funny without being tedious.

Virus Diseases of Brassica Crops, by L. Broadbent; Cambridge Univ. Press. 32 E. 57th St., N. Y. 22. 1957. 94 pp., 8 pls., 25 figs., 29 tabs. \$3.00

This report will be of value to growers of cabbage, turnips, cauliflower, brussels sprouts, broccoli, and other brassicas in all parts of the world.

Life in Fresh Water, by E. S. Brown; Oxford University Press, 114 Fifth Ave., N. Y. 11. 1955. 64 pp., illa. \$2.75

In the "Oxford Visual Series" this account of animals and plants living in fresh water ponds, streams and marshes, is sprightly in its one- and two-colored illustrations, and in its simple approach for adults with no great shakes of biological backgrounds.

Biology, by Rells B. Brown; D. C. Heath Co., 285 Columbus Ave., Boston 16, Mass. 1956. 664 pp., illa. \$6.50
56-6544

Pentagonal facets include in order the human body, the plant kingdom, animal kingdom, evolution and finally ecology.

Galathea Deep Sea Expedition, 1950-1952; ed. by Anton F. Brun, et. al; The Macmillan Co., 60 Fifth Ave. N. Y. 11. 1957. 296 pp., illa. \$8.00

Oceanography, pelagic fauna, the ethnology of forgotten islands, on a trip around the world with stops at the Seychelles, the Nicobars, Rennel and Campbell Islands, all from the most recent of the four marine biological expeditions that the seas have known.

Venoms, ed. by E. E. Buckley and N. Porges; American Association for the Advancement of Science, 1615 Massachusetts Ave., N.W., Washington 5, D. C. 1956. 467 pp., illa., figs., tabs. \$9.50
56-6108

Proceedings and papers of the first international conference on venoms, held at Berkeley, California, 27-30 December 1954, which pretty thoroughly cover the snake-bite problems of the world, with detours into the venoms of stingrays, Gila monsters, black widow spiders, and scorpions.

Progress in Nuclear Energy (Biological Sciences), ed. by J. C. Bugher, J. Coursaget and J. F. Loutit; McGraw-Hill Book Co., Inc. 330 West 42nd St., N. Y. 36. 1956. 205

pp., figs. \$7.00

The biological sciences are the sixth group to be considered in the series, and this volume includes authoritative papers on modes of radiation injury, genetic effects in man and plants, use of isotopes in agriculture, in plant nutrition, tracer techniques with Carbon 14, and radiol isotopes in mineral metabolism and in animal biochemistry.

Enzyme Antigen and Virus, by Sir F. MacFarlane Burnet; Cambridge University Press, 32 East 57th St., N. Y. 22. 1957. 193 pp., 7 figs. \$3.50

Valuable to those concerned with protein synthesis and related problems since it provides a useful summary of modern work on antibody production and virus replication.

Guide to Home Landscaping, by Donald J. Bushey; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 295 pp., 104 figs., \$4.95
55-9536

Green thumb'd "do it yourself" addicts should invest in this book before they buy, or plan a new home. There are few books as good as this one by the professor of floriculture at Cornell.

Family at Sea, by John Calwell; Little Brown & Co., Boston, Mass. 1956. 309 pp., \$4.50
56-9075

Anyone who has ever gone down to the sea in ships, particularly the South Seas, will enjoy this expanded log of a husband and wife and two small boys, who sailed a 36 foot ketch from San Diego to Sydney.

Truth About Cancer, by Charles S. Cameron; Prentice-Hall, Inc., Englewood Cliffs, N. J. 1956. 268 pp., 16 figs., 28 pls. \$4.95
56-7147

Since all the royalties earned by this book go to the American Cancer Society to help in its drive to defeat cancer, this book might have been a routine publication, but the fact is that it comes most highly recommended by medical authorities of note, and constitutes one of the most informative and unhysterical approaches in recent years to the cancer problem.

Parasites and Parasitism, by Thomas W. M. Cameron; John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16. 1956. 322 pp., 115 figs., \$6.75

This is apparently a new book, well written and interestingly illustrated, fit almost to be used as a parasitology textbook, were it not for the total absence of any discussion of Bilharziasis, a World Health Organization problem in the Nile and Red Sea area of something more than major concern.

Growing Cotton, by V. R. Cardozier; McGraw-Hill Book Co., N. Y. 36. 1957. 423 pp., illa. Price not given.
56-8859

Manual for southern growers of cotton by the specialist in vocational agriculture for the national cotton council of America. Fine reference work in northern school libraries.

Ecological Glossary, by J. Richard Carpenter; Hafner Publishing Co., 31 East 10th St., N. Y. 3. 1956. 330 pp., 12 aapen. w/maps, charts, etc. \$5.75

Republication of original 1938 Oklahoma University Press production, this work has

been off the market for years, unavailable even in second-hand bookstores, which was regrettable since it contains 3000 of the new terms which expanding ecological science developed.

Immunology and Serology, by Philip I. Carpenter; W. B. Saunders Co., West Washington Square, Philadelphia 5, Pa. 1956. 351 pp., 84 tabs., 51 figs., \$6.50

56-5082

Mostly serological in content, with 14 experiments in an appendix, it covers inoculation and bleeding of animals, hemagglutination, blood grouping, anaphyletic shock, toxin-antitoxin reaction, and mouse protection tests.

Microbiology and Pathology, by C. F. Carter and A. L. Smith; C. V. Mosby Co., 3207 Washington Ave., St. Louis 3, Mo. 1956. 970 pp., 313 figs. \$6.50

Twenty-eight years and five editions ago this book made its first diffident bow to the medical teaching public,—all of which goes to prove that it is still going strong.

Descent of Pierre Saint-Martin, by Norbert Casteret; The Philosophical Society, 15 E. 40th St., N. Y. 16. 1956. 160 pp., 24 ills., \$4.75

Grand reading for would-be spelunkers, providing the exhumation of one spelogologist and the subterranean funeral of another does not discourage.

Laboratory Manual General Biology, by E. F. Castetter, W. J. Koster, H. J. Dettmer, and M. W. Fleck; Burgess Publishing Co., 426 South Sixth St., Minneapolis 15, Minn. 1956. 175 pp., \$3.00

Second reprinting in a two year period speaks well for the reception it's getting.

Deciduous Orchards, by W. H. Chandler; Lea and Febiger, Washington Square, Philadelphia 6, Pa. 1957. 492 pp., 128 figs., \$7.50

57-7439

New flesh on old bones makes this third edition more helpful than either of its predecessors.

Cotton Growing Problems, by B. G. Christidis and G. J. Harrison; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 633 pp., 168 figs., 72 tabs., \$9.75.

55-6853

Hybridization, insect control, mechanized harvesting, irrigation, and defoliation all covered by experts from Greece and California.

Primitive Art, by Erwin O. Christensen; Studio Crowell, 432 Fourth Ave., N. Y. 16. 1955. 384 pp., 348 photos, 49 line ills., \$15.00

55-11109

Primitive symbolism grades down through use of all conceivable human forms, through fantastic or realistic animals to rare use of botanical motifs.

Ageing in Industry, by F. LeGros Clark and A. C. Dunne; The Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 153 pp., \$7.50

Results of Nuffield Foundation studies on 32 occupations would seem to indicate the job survival rates depends on the degree of specialization and craftsmanship, musical instrument makers being among the best off.

Introduction to the Bacteria, by C. E. Clifton; McGraw Hill Book Co., 330 West 42nd

St., N. Y. 36. 1957. 528 pp., ills.*\$8.50

Reprinting of the 1950 volume which has had enough to commend it on the score of freshness of concept and approach to warrant its reissue.

Botany of Tropical Crops, by Leslie S. Cobley; Longmans, Green & Co., 55 Fifth Ave., N. Y. 3. 1956. 357 pp., 32 pl., 66 figs., \$7.25

Although designed for students in tropical schools, this book should prove a valuable adjunct to any course that fringes on economic botany.

Elements of Genetics, by Edward C. Collin; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 498 pp., 152 figs., \$5.75

55-11561

Third edition of the 1941 original includes chapters on domesticated plants and animals, retains the good features of previous editions which made it such a fine textbook.

Radioisotopes in Biology and Agriculture, by C. L. Colmar; McGraw-Hill Book Co., 330 West 42nd St., New York 36. 1955. 481 pp., figs., tabs., \$9.00

54-11261

A useful compilation which brings together in one volume the necessary biological as well as chemical information for planning and carrying out tracer studies on plants and animals.

How to Know the Mosses and Liverworts, by H. S. Conard; Wm. C. Brown, Dubuque, Iowa. 1956. 226 pp., 372 figs., \$2.50 spiral, \$3.00 cloth bound.

This is a revised edition of the original 1944 work which has interested a lot of people.

Chazyan and Related Brachiopods, by G. Arthur Cooper; Smithsonian Institution, Washington 25, D. C. 1956. 2 vols. 1245 pp., 269 pl., \$20.00

Fossil brachiopods from Newfoundland, the valleys of the St. Lawrence, Ottawa, Champlain, Mohawk and Hudson basins, the Appalachian (southern), Tennessee, Indiana, Mississippi Valleys, the Arbuckle and Wichita Mountains, the Black Hills, the Great Basin, and formations in Utah and California.

Classification of Lower Organisms, by Herbert F. Copeland; Pacific Books, Box 558, Palo Alto, Calif. 1956. 302 pp., 45 figs., \$7.50

56-7944

Treats of the lower plants and the lower animals, coming close to Haeckel's non-animal non-plant group, the Protista, (minus the bacteria).

Energy and Society, by Fred Cottrell; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 330 pp., \$6.00

Socio-economic study which treats briefly of plants and animals as energy converters, but spends most of its time on the development of civilization through the history of fuel sources.

Hawks, Owls and Wildlife, by J. J. and F. C. Craighead; Stackpole Co., Harrisburg, Pa. 1956. 443 pp., 100 tabs., 64 pls., 22 maps. \$7.50

A definitive study on the ecology of raptor predation, in two parts, the first in Fall and Winter, the second in Spring and Sum-

mer. It remains to be seen how much local prejudices against hawks and owls will be affected by these results.

Genetics Notes, by J. F. Crow; Burgess Pub. Co., 426 S. 6th St., Minneapolis 15, Minn. 1955. 124 pp., \$3.00

Concise, complete summary of the principles taught at the University of Wisconsin, designed to be a substitute for minutely scribbled class notes.

Plant Ecology, by J. T. Curtis; Burgess Publishing Co., 426 South Sixth St., Minneapolis, Minn. 1956. 86 pp., maps, data sheets, \$3.75

Lab manual, field workbook, reference guide, and bibliography all combined in one spiral bound volume.

Cerebral Palsy, ed. by W. W. Cruickshank and G. M. Raus; Syracuse University Press, Box 87, University Etation, Syracuse 10, N. Y. 1955. 560 pp., 38 figs., \$7.50

Twelve professional authorities cooperated in preparing this book on diagnosis and planning for the cerebral palsied child.

Food Poisoning, by G. M. Dack; University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill. 1956. 251 pp., 13 tabs., \$6.00

Third edition since 1943 covers chemicals in food, poisonous plants and animals, botulism, staphylococcus, salmonella, streptococcus, and other food poisoning organisms.

White-Tailed Deer in Wisconsin, by B. L. Dahlberg and R. C. Guettinger; Game Management Division, Wisconsin Conservation Department, Madison 1, Wis. 1956. 282 pp., ills. Free.

Deer management as the Wisconsin Conservation Commission learned it the hard way, and plans it is making to continue learning, illustrated by a rare collection of old and new wildlife pictures.

Forest and Range Policy, by Samuel T. Dana; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 455 pp., \$6.50

The history of forest and range policy as it has developed in the U.S.A. from 1609 to now.

What You Should Know About Snakes, by George W. Danforth; Citadel Press, 222 Fourth Ave., N. Y. 3. 1956. 127 pp., 55 figs., \$3.00

Lt. Comdr. George W. Danforth, U.S.N. Ret. makes an excellent attempt to sink the foolish superstitions which have grown up around the reptiles since biblical times, in a book that is mighty interesting, informal, and not a bit scientifically egg-head.

Chromosome Botany, by C. D. Darlington; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 186 pp., 36 figs., 17 tabs., \$2.75

The most interesting book that Darlington or anyone else in the botanical field has published in years, dealing as it does, in part with the migrations of plants and their chromosome numbers, plus a lot of taxonomy, geography, ecology and evolution.

Abbe Correa in America, by Richard Beale Davis; American Philosophical Society, In-

dependence Square, Philadelphia 6, Pa. 1955. 111 pp., 6 ills., Paper. \$2.00

Tennessee's Professor of American Literature has done well by his subject,—one of the really unusual characters in early American diplomacy,—he was a correspondent of Linnaeus, a friend of Presidents Jefferson, Madison and Monroe, intimate of Bigelow and Wistar, as well as envoy extraordinary of Portugal and Brazil, a lax priest, and a botanist of no mean ability.

Man, His Life, His Education, His Happiness, by A. da Silva Mello; Philosophical Library, 10 East 40th St., N. Y. 16. 1956. 729 pp., \$6.00

Lucid English translation of a famous Brazilian psychoanalyst's anti-Freudian psychology of life and medicine.

Biology of Plants, Laboratory Exercises, 3rd ed., by H. L. Dean; Wm. C. Brown Co., Dubuque, Iowa. 265 pp., 101 ills., 53 pl. \$2.90

Continued demand for newer editions of this work would seem to justify our previous favorable estimate of earlier editions.

Man and the Winds, by E. Aubert de la Rue; Philosophical Library, 15 East 40th St., N. Y. 16. 1955. 206 pp., 26 ills., \$6.00

Absly translated French work on the winds as they affect the human race, especially in Europe and Africa.

General Biology Laboratory Guide, by A. P. Davission; Burgess Pub. Co., 426 So. Sixth St., Minneapolis 15, Minn. 1956. 160 pp., 76 figs. \$3.75

Spiral wire-bound lab workbook with 30 pages on the frog, 51 in animal classification, 42 on typella plant groups.

Poliomyelitis, Debre et al; World Health Organization, Palais des Nations, Geneva, Switzerland. 1955. 408 pp., \$8.00

Thirteen definitive articles by 17 competent professionals covering epidemiology, clinical aspects, virology, immunology and control.

Chemistry and Uses of Pesticides, by E. R. de Ong; Reinhold Publishing Corp., 430 Park Ave., N. Y. 22. 1956. 334 pp., 19 tabs., 18 figs., \$8.75

Second edition which becomes the latest word on nature and use of insecticides, fungicides, herbicides, rodenticides, repellants and seed disinfectants.

Diseases of Field Crops, by James G. Dickson; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 517 pp., 102 figs., \$8.50

Thoroughly revised second edition of a proven textbook which should confer added distinction upon its already famous author and the university in which he is professor of plant pathology.

Genetics, by Edward O. Dobson; W. B. Saunders Co., West Washington Square, Philadelphia 5, Pa. 1956. 329 pp., 159 figs., \$6.50

This book puts genius and energy into the teaching of genetics since it is impossible to lay it down even after a grief spate of reading without having caught a new perspective or a new approach.

Biological Basis of Human Freedom, by Theodosius Dobzhansky; Columbia University Press, 2960 Broadway, N. Y. 27. 1956. 139 pp., \$2.95

56-11981

Readers will be amply rewarded by this lucid, masterly expression of ideas fundamental to an understanding of basic problems such as how and why the highest illumination achieved by science is seen to affirm man's unique dignity in the scheme of life.

Evolution, Genetics and Man, by Theodosius Dobzhansky; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1955. 398 pp., 107 ills., \$5.50

55-10868

"What can be more challenging and inspiring to a student of average and above average intelligence than to learn that science is not something all completed and finished, merely to be memorized from books, but a growing body of knowledge, in the development of which this same student may have a hand if he so chooses." (From the preface.)

Liberty Hyde Bailey, by Philip Dorf; Cornell University Press, 124 Roberts Place, Ithaca, N. Y. 1956. 259 pp. \$3.50

Liberty Hyde Bailey, as the author of this book sums him up, was a teacher and administrator, author and editor, scientist, naturalist, poet and philosopher, and always the individualist,—and probably best merited the журнаlese accolade of "Mr. American Botany."

Androgens, by R. I. Dorfman and R. A. Shipley; John Wiley & Sons Co., 440 Fourth Ave., N. Y. 16. 1956. 590 pp., figs., tabs. \$13.50

55-9357

Including both the theoretical as well as the clinical discoveries on androgens for the first time assembled in one book.

Improving Your Garden, by Earl Downey; Crown Publishers, Inc., 419 Fourth Ave., N. Y. 16. 1955. 250 pp., ills. \$3.95

55-7237

Here is an author, who, as founder and president of The Soil Analysis Service, is not afraid to take the bull by the horns, instead of somewhere else, and who is game enough to sum up,—under the topic "Gloxinias,"—"African violets are grown in the same manner as gloxinias."

Miracle of Royal Jelly, by R. DuBois, Tr. by C. Demrick; L. R. Smith Co., Box 2003, Hartford, Conn. 1955. 95 pp., ills. \$2.50

A rather unusual little book which holds out the promise of the apiculturists' royal jelly as a sort of Fountain of Perpetual Youth.

Natural History of a Yard, by Leonard Dubkin; Henry Regnery Co., 20 West Jackson Blvd., Chicago 4, Ill. 1955.

55-8801

The yard is only the small hedged grass plot in front of a Chicago apartment house, but the naturalist sees as much in it as Thoreau did in Walden Pond.

Human Physiology, Laboratory Manual, by A. R. Dawe and Robert T. Schopp; Henry Holt & Co., 383 Madison Ave., N. Y. 17. 1957. 147 pp., ills., charts., \$2.25

A new manual which should materially aid in making human physiology dynamic, not static.

Fields of Force, by Winifred Duncan; Theosophical Publishing House, 68 Great Russell St., London, W.C.1, England. 1956. 67 pp., paper.

An attempt to find out how and where science and metaphysics have met... in the hope that it may interest those who would feel more comfortable about life if they could think scientifically, religiously and philosophically at the same time.

Fundamentals of Horticulture, by J. B. Edmond, A. M. Musser and F. S. Andrews; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1957. 456 pp., 148 figs., 30 tabs. \$6.75

56-10311

The editor is one of those general botany teachers who gives an introductory course in horticulture in alternate years and who can speak from personal experience how helpful the first edition of this text has been. In its revised edition it should be even more useful.

Geology and Ourselves, by F. H. Edmunds; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 256 pp., 12 pl., 15 figs. \$10.00

Another British book which should help to personalize one's knowledge of geology.

How to Grow Roses, ed. by J. P. Edwards; Lane Publishing Co., Menlo Park, Calif. 1955. 88 pp., ills. \$1.50

55-11802

Another good example of the well-written and down-to-earth guide book put out under the Lane Company's "Sunset Book" imprint.

Concise Anatomy, by Linden Edwards; McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 34. 1956. 502 pp., 319 figs., \$7.50

56-6893

Second and revised edition of the 9-years-old original, includes treatment of body parts on the regional rather than the systematic plan, with developmental and histological features and terminal paragraphs on applied anatomy in most of the chapters.

Heterocyclic Compounds, Vols. 5 and 6, by Robert C. Elderfield; John Wiley & Sons; 440 Fourth Ave., N. Y. 16. 1957. 744 and 753 pp. Vol. 5, \$20; Vol. 6, \$25.

50-7589

Vol. 5 includes the Five-membered Heterocycles containing two Hetero Atoms and their Benzo Derivatives. Vol. 6 covers the Six-membered Heterocycles containing two Hetero Atoms and their Benzo Derivatives. Made up of contributions by outstanding leaders in their respective fields.

Atlas of Animal Anatomy for Artists, by Ellenberger, Baum and Dittich; Dover Publications, Inc., 920 Broadway, N. Y. 10. 1956. 153 pp., ills., \$6.00

Revised and extended version of the 1949 translation of the many German editions. Should be indispensable in art schools where some attempt is made towards realism. Much too refined for the symbolic schools which favor adolescent primitives and rely on the head instead of the heart.

Water Relations of Terrestrial Arthropods, by E. P. Edney; Cambridge University Press, 32 East 57th St., N. Y. 22. 1957. 109 pp., 32 figs., \$3.00

Neat little monograph, heavily bibliographed. British, of course.

Expectant Motherhood, by Nicholas J. Eastman, M.D.; Little, Brown & Co., 34 Beacon St., Boston 6, Mass. 1957. 198 pp., 13 figs., \$1.75

A book for those in this condition, together with spaces inside the front cover for the doctor's name, address, and telephone,—ditto for the hospital. It is to be hoped the femme encienne will not wait until the latter are needed before reading the book.

Dictionary of Dietetics, by Rhoda Ellis; Philosophical Library, 15 East 40th St., N. Y. 16. 1955. 152 pp., \$6.00

If you don't know what the dieticians are talking about, this is IT. But acne vulgaris never occurs on castrated males!

Syllabus Der Pflanzen-Familien, by A. Engler; Stechert-Hafner, Inc., 31 East 10th St., N. Y. 3. 1954. 367 pp., 140 figs., \$10.00

We have waited over-long for the republication of the Engler classics in plant taxonomy. This 12th edition ranges through the Eubacteriales, the Algae, the Fungi and Lichens, the Bryophytes, Pteridophytes and the Gymnosperms, ending with the Gnetaceae. The second volume is expected about the end of the present year, or early in 1958. It can't come too soon.

Lawns and Landscaping, by Thomas H. Everett; Arco Publishing Co., 480 Lexington Ave., N. Y. 17. 1956. 144 pp., 273 photos, 30 drawings. \$2.00

Probably the most thorough, practical and interesting book of lawns now on the book shelves. It can also be had in a Fawcett Book edition, from Dept. 302, Greenwich, Conn., for 75 cents with 10 cents extra for mailing if you figure you won't be using it permanently, since it is only paper-covered.

Thresholds of Existence, by Upton C. Ewing; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 286 pp., 4 figs., \$3.75

Philosophical Library apparently exists to give everyman a chance to rationalize his own life thinking. Chapter headings in this book include: "natural selection an allegory or a power, thotonic energy, abstracting incidental inception, vegetal mind, natural law and prayer, future evolution, the shameful contingency." The book is singularly innocent of any bibliographies or cross references.

Fascinating Insect World, by J. Henri Fabre; Fawcett World Library; 67 East 44th St., N. Y. 36. 1956. 191 pp., 35 cents

This is a paper-backed, representative reproduction of the original A. T. Mattos version.

Spring Flora of Wisconsin, by Norman C. Fassett; U. of Wis. Press, 811 State St., Madison, Wis. 1957. 189 pp., 415 ill., \$2.50
57-5043

Dr. Fassett would have been tremendously enthused about the clean-cut appearance of this third edition of his handy companion to Spring in Wisconsin. His sudden death rallied a lot of his friends at the University to see that his last work, the revision he had started, was satisfactorily completed. They have built the best monument he might have wished for.

Manual of Aquatic Plants, by Norman C. Fassett; U. of Wis. Press, 811 State St.,

Madison, Wis. 1957. 405 pp., 68 ill., \$6.50
57-6593

The 1940 edition of Dr. Fassett's classic work has been completely worked over by E. C. Ogden, New York State Botanist, of the New York Museum and Science Service. He has contributed a revision appendix of 25 pp., which, together with the appendix on the use of plants by birds and mammals should continue this work in its premiere position as a reference for conservationists everywhere.

Integrated Anatomy and Physiology, by C. C. Francis and G. L. Farrell; The C. V. Mosby Co., 3207 Washington Blvd., St. Louis 3, Mo. 1957. 641 pp., 367 figs., \$1 col. pl., \$5.85

Based on the integration of structure and function, this 3rd edition in 14 years comes from the departments of anatomy and of physiology at Western Reserve University.

Orchids for Home and Garden, by T. A. Fennell, Jr.; Rinehart & Co., Inc., 232 Madison Ave., N. Y. 16. 1956. 130 pp., 27 figs., 8 col. pl., 12 ill., \$2.95

56-6251
Introduced by Philip Wylie. this book is a lot of information considering the price asked for it.

Speciation of the Wandering Shrew, by James Findlay; Univ. of Kansas Publ., Lawrence, Kansas. 1955. 68 pp., 18 figs. Free

Item No. 1, in Vol. 9 of the Museum of Natural History publications at the U. of Kansas.

Myology of the Whooping Crane, by H. I. Fisher and D. C. Goodman; University of Illinois Press, Urbana, Ill. 1955. 127 pp., 40 figs., \$2.50

55-6941
The preserved specimens of the whooping crane are even fewer than the living ones, so this careful study is all the more valuable in view of the possible extinction of the species.

Butterflies, by E. B. Ford; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1957. 368 pp., 48 col. pl., 32 maps, 24 pls. 9 figs., \$6.00

This is the sort of book you waste time over,—first because we Americans get few chances to chase British butterflies, second because few of the British butterflies migrate our way, third because once you pick this beautifully illustrated book up, you can't lay it down Now, if you entomologists, amateur or professional, persist in buying it, don't say you weren't warned.

Climates in Miniature, by T. Bedford Franklin; Philosophical Library, 15 East 40th St., N. Y. 16. 1955. 137 pp., 11 figs., 8 ill.

All about frost hollows and dew ponds, cloches and frames, and such like Scottish and English climatic conditions, with a whole chapter on Wisconsin cranberry-growing practices.

Pesticide Handbook, by D. E. H. Frear; Pesticide Hand Book. P. O. Box 798, State College, Pa. 208 pp., \$3.00 cloth, \$1.25 paper

A check list of 6111 commercial pesticides, their active ingredients, manufacturers and uses.

French Doctoral Theses, (Sciences 1951-1953), Andre Gauvenet; French Cultural Services, 972 Fifth Ave., N. Y. 21. 1953. 75 pp. Free

Lists all theses accepted by French schools of science during the period.

Insects and Spiders, by C. P. Friedlander and D. A. Priest; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 124 pp., 21 pls. \$2.75

A book of keys with biological notes, simplified but clear, for British youngsters who seem to be able to read books like these.

Genetics Laboratory Exercises, by Eldon J. Gardner; Burgess Pub. Co., 426 So. 6th St., Minneapolis 15, Minn. 1956. 47 pp., 14 figs. \$2.50 spiral wire bound

Second edition of a lab manual which has proved itself in the course of four years.

Biology of Root-Infecting Fungi, by S. D. Garrett; Cambridge University Press, 32 East 57th St., N. Y. 22. 1956. 293 pp., 9 tabs. \$5.50

The past-president of the British Mycological Society surveys the entire field, with an interesting chapter on mycorrhizal infections, and a 31-page bibliography.

Admission Requirements of American Medical Colleges, by Helen Hofer Gee; Association of American Medical Colleges, 185 N. Wabash Ave., Chicago 1, Ill. 1957. 193 pp., 16 tables. \$2.00 paper

A reference work which should be available on every student counselor's desk where pre-medical courses are offered.

History of the British Flora, by H. Godwin; Cambridge University Press, 32 East 57th St., N. Y. 22. 1956. 384 pp., 119 figs., 26 pls., tables. \$16.50

Plant remains of the Quaternary, based on pollen analysis and accompanying plant remains of the periods. Magnificently handled. It will be interesting to see how carbon-14 results will check with Dr. Godwin as time goes on. This book is a "must" for the graduate botany library.

Genetics Is Easy, by Philip Goldstein; Lantern Press, 257 Fourth Ave., N. Y. 10. 238 pp., 65 figs. \$4.00

Should be in every public library. 55-8304

How to Fish From Top to Bottom, by Sid Gordon; The Stackpole Co., Telegraph Press Bldg., Harrisburg. Pa. 1955. 394 pp., 126 figs. \$5.00

55-11695
Wisconsin and Michigan people, fishermen especially, will relish this book, as will the entomologists, who will, perhaps, find some new insect forms to use as bait.

Laboratory Manual for Students of Agronomy, by L. F. Graber; Wm. C. Brown Co., Dubuque, Ia. 1956. 229 pp. Price not mentioned.

The author, who entered Phi Sigma at the University of Wisconsin before the Editor, sent this copy of the 9th edition of a tested and proven laboratory manual to us for an announcement. It is something more than agronomic in scope, integrating elementary biological facts, and world biogeography.

Essays in Biochemistry, ed. by Samuel Graff; John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16. 1956. 345 pp., \$6.50

56-7155

Twenty-five essays form this *fest-schrift* honoring Dr. Hans Thacher Clarke on his retirement as professor and department chairman in biochemistry, at the College of Physicians and Surgeons, at Columbia. As such, we get many a peek into research in progress.

Illustrated Guide to Trees and Shrubs, by A. H. Graves; Harper & Brothers, 51 East 33rd St., N. Y. 16. 1956. 271 pp., 116 figs., 45 pls. \$6.00

56-6044

Third edition of a manual whose greatest distinction is the striking effectiveness of its illustrations.

Field and Stream Treasury, ed. by Hugh Grey and Ross McCluskey; Henry Holt & Co., 385 Madison Ave., N. Y. 17. 1955. 351 pp., 41 ill., 8 in col. \$5.00

55-10675

Anthology of best articles printed in the 60 years of "Field and Stream's" existence as a sportsman's and conservationist's (we say this advisedly) magazine.

Anatomy of the Rat, by Eunice Chace Green; Hafner Pub. Co., 31 East 10th St., N. Y. 3. 1955. 370 pp., 339 figs. \$25.00

Twenty years ago the first edition of this book, lithographed, if we remember correctly, was favorably summarized in this magazine. The present opulent edition is a comforting reassurance of the correctness of our estimate, at least once.

Sexuality, Love and Immortality, by J. P. Grip; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 121 pp. \$3.50

J. P. Grip neither gripes nor grips us.

New Course of Plants and Animals, by M. A. Grigg; Cambridge University Press, 32 E. 57th St., N. Y. 22. 1956. 216 pp., 139 figs. \$1.50

This biology at grade school level for boys and girls could be a model for American teachers if they wanted to work themselves, and had children old enough to read for themselves.

Seaweeds at Ebb Tide, by Muriel L. Gubert; University of Washington Press, Seattle 5, Wash. 1956. 182 pp., 87 ill., \$3.50

56-9308

A guide book, popularly written, but scientifically accurate, to the algal denizens of the shore lines of our Pacific coast. The author is a professional writer, a student at Friday Harbor Laboratory, and her illustrator is a professional artist.

Creatures of the Deep Sea, by Klaus Guenther and Kurt Deckert; Charles Scribner's Sons, 597 Fifth Ave., N. Y. 17. 1956. 222 pp., 140 figs., 6 tabs. \$3.95

Translated from the German, this book opens up some aspects of deep sea life, all zoological, that most of us otherwise would have no access to. The Beebee bathysphere is described.

Medical and Biological Staining Techniques, by E. Gurr; Interscience Publishers, 250 Fifth Ave., N. Y. 1. 1956. 451 pp., 1 ill. \$6.25

Judging from the meticulous directions afforded by the author you will not go wrong with Gurr. He even gives criteria by which the histologist can check his own results.

Introduction to Electron Microscopy, by Cecil E. Hall; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1953. 451 pp., ills. \$9.00
52-13005

A manual for those who wish to lick the electron microscope at its own game.

Biological Made Simple, by Ethel R. Hanauer; Garden City Books, N. Y. 1956. 192 pp., 209 figs. \$1.00

What this paper-bound high-school text book lacks in its type of illustrations, it makes up in the comprehensiveness of its subject matter. Multa, sed non multum.

Japanese Gardens, by Jiro Harada; Charles T. Branford Co., 69 Union St., Newton Centre 59, Mass. 1956. 160 pp., 200 ills. \$8.50

Gardening had a religio-mystic place in ancient Japanese life. One has either to see and understand the meaning of each small use of animate or inanimate materiel to appreciate its meaning. This sumptuous book will help.

Transport and Accumulation in Biological Systems, by E. J. Harris; Academic Press, 111 Fifth Ave., N. Y. 3. 1956. 291 pp., 54 figs., 43 tabs., 7 pls. \$7.80

Gathers more recent information on cellular inorganic chemistry, and the kinetics of movement of inorganic and simple organic substances between cells and their surroundings.

Dissection of the Cat, by B. M. Harrison; C. V. Mosby Co., 3207 Washington Blvd., St. Louis 8, Mo. 1956. 217 pp. \$3.50

This is the third edition of a practical and successful dissection manual for comparative anatomy.

American Arbacia and Other Sea Urchins, by Ethel Browne Harvey; Princeton University Press, Princeton, N. J. 1956. 293 pp., 16 pls., 19 tabs., 12 figs. \$6.00

145 pages on subject matter, 85 pages compilation of experimental work, 54 pages on bibliography (amounting to nearly 1,500 titles) make up this monument to the memory of the doyen of American cytologists. He would have been worried about it, while he loved it.

Introduction to Botany, by Arthur W. Haupt; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 447 pp., 297 figs., \$5.50
55-5685

The new Haupt is a straightforward essay on general botany, with no attempt to titillate the modern "project" theorists. Somehow or other, we feel that students who work under its aegis will learn just as much, if not more botany, as those who are "exposed" to more entertaining types of visual education.

Beginnings: Genesis and Modern Science, by Charles Hauret; The Priory Press, Dubuque, Iowa. 1955. 304 pp., \$3.25

This latest approved pronouncement of the relations between church and science will surprise some who are not Catholics and scandalize the Catholics. Should be in all school libraries.

Reproduction in Fungi, by Lilian E. Hawker; Cambridge University Press, 32 East 57th St., N. Y. 22. 1957. 128 pp., 5 figs., \$3.00

Covers spore growth, physiology of vegetative reproduction, effects of environment on sporulation, effects of nutrition, physiology of sex, and reproduction in natural habitats.

Evolution of Human Nature, by C. Judson Herrick; University of Texas Press, Austin, Texas. 1956. 506 pp., 16 figs., \$7.50
56-7393

One of the world's foremost neuro-anatomists sums up his life-work in this new classic. "Its publication will render a great service to science and th humanities." (Ashley Montague) The author's epilogue "The Unknown God" is especially revealing.

Flowering-Plant Taxonomy, by J. Heslop-Harrison; Harvard University Press, Cambridge, Mass. 1956. 135 pp. \$1.25

"Study of living natural populations, rather than arbitrarily selected, dead, individuals. A practical study of evolution . . . yielding facts of importance in classification, usually at the species level."

Primates, by W. C. Osman Hill; Interscience Publishers, 250 Fifth Ave., N. Y. 1. Vol. I, 1953, Vol. II, 1955. Vol. I, 798 pp., 199 figs., 34 pls. \$15.75. Vol. II, 347 pp., 49 figs., 14 pls. \$9.50

Devoted to the comparative anatomy of the primates, Vol. I covers the Strepsirhini, while Vol. II covers the Haplorhini, with special attention to the Tarsiodea. Subsequent volumes will be devoted to the Platyrrhini, and to the Catarrhine monkeys and the Anthropoids.

Introduction to Research, by Tyrus Hillway; Houghton Mifflin Co., 2 Park St., Boston, Mass. 1956. 284 pp. \$3.50

Horse sense for graduate students, with n "projects" added.

Perennial Species of Sidalcea, by C. L. Hitchcock and A. R. Kruckeberg; University of Washington Press, Seattle, Wash. 1957. 96 pp., 1 fig. 5 mps. \$2.00
57-62501

First half is devoted to their taxonomy, second half to chromosome numbers and inter-specific hybridizations.

Vascular Plants of the Pacific Northwest, by C. L. Hitchcock, A. Cronquist, M. Ownby and J. W. Thompson; University of Washington Press, Seattle, Wash. 1955. Vol. V, 343 pp., \$7.50

This Part 5, devoted to the Compositae, is the first published in the forthcoming five books of Volume 17, which will cover the field, and fill in a long unfilled gap in our national taxonomy.

Travels and Traditions of Waterfowl, by H. Albert Hochbaum; University of Minnesota Press, Minneapolis 14, Minn. 1956. 301 pp., ills. \$5.00
55-11707

Both written and illustrated by the author who is the director of the Delta Waterfowl Research Station in Manitoba, this engrossing book has many new ideas to add to those currently held about bird movements or home ranges and migration.

Life and Death of Cells, by Joseph G. Hoffman; Doubleday & Co., 575 Madison Ave., N. Y. 22. 1957. 301 pp. \$4.50
57-6302

The professor of biophysics at the Univer-

sity of Rochester's School of Medicine here takes his chance to explain the problems of life and death in physical terms. The role of mutation in cancer study is also developed.

Radiation Biology, Vol. 3, Visible and Near-Visible Light, ed. by Alexander Hollaender; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 765 pp., ills., \$10.00

53-6042

This is the third volume in a series on Radiation Biology which are being edited by a former member of Zeta Chapter of Phi Sigma. It includes 15 papers by Lumry, Eyring, Platt, the Withrows, Daniels, Wassink, French, Young, Smith, Burstrom, Went, Borthwick, Hendricks, Parker, Evenari, Stoelfelt, the Milnes and Clare.

Home Gardening Encyclopedia, (No Author); Philosophical Library, 15 East 40th St., N. Y. 16. 1955. 368 pp., 31 charts, 32 ills., 5 pl. in color. \$6.00

For areas which approximate the British Isles in temperature and humidity conditions as well as soil complexes, this should be an excellent book. It certainly is a large \$6.00 worth.

Free Films, Educators Guide to, by A. P. Horkheimer; Educators Progress Service, Randolph, Wis. 1956. 560 pp. \$6.00

This is a paper-bound reference work which should be available in every library, college, community or high school.

Principles of Fungicidal Action, by J. G. Horsfall; Chronica Botanica Co., Waltham, Mass, or Hafner Pub. Co., N. Y. 1956. 280 pp., 16 figs., 11 tabs. \$6.50

The director of the Connecticut Agricultural Experiment Station presents his approach to the problems of fungitoxicity, as he calls it. To us it would seem to be more of a current history of fungicidal action, because he certainly has approached it from the historical angle. It's interesting.

Biology and Taxonomy of North American Beetles of the Subfamily Geotrupinae with Revisions of the Genera *Bolboceroma*, *Eucantheus*, *Geotrupes* and *Peltotrupes* (Scarabaeidae), by H. F. Holden; Smithsonian Institution, U. S. National Museum, Washington, D. C. 1955. 168 pp., 13 ppis. No price listed.

Handbook of Ostracod Taxonomy, by H. V. Howe; Louisiana State University Press, Baton Rouge 3, La. 1955. 386 pp. \$5.00 paper

On the "Caveat Emptor" principle, anyone entering in running down specimen ostracoda should be warned against this book. It may be an excellent handbook of ostracod taxonomic literature, but it certainly is no taxonomy, as taxonomies are generally accepted today.

Naturalist in Palestine, by Victor Howells; Philosophical Library, 15 East 40th St., N. Y. 16. 1957. 180 pp., 29 pls., 12 figs., \$6.00

Since Palestine and Transjordan no longer exist as geographical entities, this book is about countries which no longer exist—and probably about biological conditions which have been forever disrupted with the development of some of the new nations which have taken over. It is somewhat of a nostalgic narrative of the 11 months before the Mandate.

British Wild Flowers, Vols. I and II, by John Hutchinson; Penguin Books, Inc., 3300 Clipper Mill Road, Baltimore 11, Md. 1955. 947 pp., 800 ills., 95 cents each, paper.

The author's original "Common," "More Common," and his "Uncommon Wild Flowers" have been rearranged into two volumes to form one of the most complete national wild flower manuals.

Ornithologists Guide, by H. P. W. Hutson; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 275 pp., 34 figs., \$10.00

Suggested and edited by Maj. Gen. H. P. W. Hutson, this book is chock-full of suggestions for field ornithologists in the British Dominions. Forty-five contributors have added their share of information, and it simply reeks of reference works. Could you ring a penguin's flipper? See a deticking party?

World of Plant Life, by C. J. Hylander; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 653 pp., 700 line drgs., 190 pls., \$8.95

Your Editor and the Author of this book sat side-by-side for one summer session at the Marine Biological Laboratory. We were both graduate students then. He was gathering, perhaps subconsciously, the materials which now go to make up such surveys of the plant world as this fascinating and informative book.

Invertebrates, Vol. IV, by Libbie H. Hyman; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 763 pp., 280 figs., \$10.00

40-5368

Not merely detailed accounts of the anatomy, embryology, physiology and ecology of the echinoderms, but a unified treatment of the coelmate Bilateria as a whole, instead of type specimens.

Anatomical Atlas, by Maud Jepson; Rinehart & Co., 232 Madison Ave., N. Y. 16. 1957. 25 pp., 107 ills. \$0.75

How Vesalius would have enjoyed and liked this atlas?

Genus *Achlys*, by T. W. Johnson; University of Michigan Press, Ann Arbor, Mich. 1956. 180 pp., 22 pls., \$4.50

56-62503

A taxonomic as well as historical study of one of the world-common water molds.

Laboratory Manual for General Biology, by W. H. Johnson, R. A. Laubengayer and L. E. DeLanney; Henry Holt & Co., 383 Madison Ave., N. Y. 17. 1956. 174 pp., ills., \$2.75

All neatly packaged up into units so the pupils won't notice that they have left high-school, this manual has several refreshingly new tests to demonstrated some of the more elemental biological processes.

General Biology, by W. H. Johnson, R. A. Laubengayer, and L. E. DeLanney; Henry Holt & Co., 383 Madison Ave., N. Y. 17. 1956. 617 pp., ills., \$6.95

56-6056

By far the most complete general biology text on the schoolbook market today, should be useful in two-semester 10-credit course. (We don't see how all the material suggested could be covered in less.)

Adrenal Cortex, by I. Chester Jones; Cam-

bridge University Press, 32 East 57th St., N. Y. 22. 1957. 316 pp., 35 figs., 30 tabs., 9 pls., \$7.00

First monograph to give a comprehensive account of the workings of the adrenal cortex in the various species among the vertebrates. Has a 55-page bibliography.

Comparative Anatomy of the Vertebrates, by G. C. Kent, Jr.; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1954. 530 pp., 405 figs. \$6.50

54-9334

Designed for a 1-semester course, the chapters of this book emphasize the conformity of vertebrate parts to more than their differences from, the basic plan or pattern.

Micro-Analysis in Medical Biochemistry, by E. J. King and I. D. P. Wootton; Grune & Stratton, 381 Fourth Ave., N. Y. 16. 1956. 292 pp., 18 tabs., 25 figs., \$4.00

Two staff members of the Univ. of London

Postgraduate Medical School cooperate in the revision of the senior author's 1946 work which has since run through two editions in English as well as translations into Spanish, Italian and Serbo-Croat.

Rattlesnakes, by Laurence M. Klauber; Univ. of California Press, Berkeley 4, Calif. 1956. 1476 pp., 172 ill., \$17.50

56-5002

Monolithic two-volume monograph on the most feared snakes in North America.

Genes, Genesis and Evolution, by John W. Klotz; Concordia Publishing House, 3558 So. Jefferson Ave., St. Louis 18, Mo. 1955. 575 pp., 72 pp. \$5.00

55-6434

Klotz regards evolution not as the development of higher organisms from lower but rather as a finite amount of change within fixed and closed systems. His "problems for Evolutionists" chapter is terrific. As one Editor said of this book, "but why circumscribe the limits of Divinity. If we accept evolution at all, why not go the whole way."

The Microbe's Contribution to Biology, by A. J. Kluyver and C. B. van Niel; Harvard University Press, Cambridge, Mass. 1956. 182 pp., 35 figs., 12 tabs., \$4.00

56-5342

The 1954 Prather Lectures at Harvard are here developed into a rather challenging little book whose six chapters include the metabolism of microbes in relation to the energetic basis of life as well as the clue to life's unity, the phototrophic bacteria and photosynthesis, microbial adaptation and life's flexibility. mutations, and microbial evolution.

Geraniums for Home and Garden, by H. K. Krauss; Macmillan Co., 60 Fifth Ave., N. Y. 11. 194 pp., 16 pls., \$5.00

Most complete and interesting book so far written on the subject, consists of three parts of which the first is historical, the second describes over 1,000 varieties, and third gives cultural directions.

Voice of the Desert, by J. W. Krutch; William Sloane Associates, 425 Fourth Ave., N. Y. 16. 1955. 223 pp., 16 pls., \$3.75

55-8485

A sound naturalist in the philosophical rather than the merely botanical or the biological sense, describes the desert and life reactions that go on in it.

Great Chain of Life, by J. W. Krutch; Houghton Mifflin Co., 2 Park St., Boston, Mass. 1956. 227 pp., \$3.75

56-13104

Bland philosophizing by a gentle naturalist. His plea for biology as a liberalizing element in the liberal arts curriculum is apt and much needed if the biologists are going to continue to have anything to offer the thinking world.

Weathercasting, by C. and R. Laird; Prentice-Hall, 70 Fifth Ave., N. Y. 11. 1955. 163 pp., 54 figs., 9 code tabs., \$3.95

55-8468

A fascinating book for those who would like to make weathercasting a hobby. There are no books recommended for outside reading.

How to Make Cacti Flower, by Edgar Lamb; Pitman Pub. Corp., 2 West 45th St., N. Y. 35. 1955. 80 pp., 50 figs., \$1.95

One hundred of the more common and popular varieties here described and treated.

Lamotte Soil Handbook, by C. V. B. LaMotte; Research Department, LaMotte Chemical Products Co., Towson 4, Baltimore, Md. 1955. 66 pp., ill., \$0.25

Valuable for horticulture, and gardening, especially where soil conditions preclude use of plants whose pH demands are incompatible.

Physiology of Man, by L. L. Langley and E. Cherskin; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1954. 609 pp., 180 figs., 16 tabs. \$6.00

53-9006

Dedicated to the proposition that learning can be fun, this book bids fair to displace many another which is dedicated to the fact that learning, and the learned, must be dull.

Men Under the Sea, by Egon Larsen; Roy Publishers, 30 East 74th St., N. Y. 11. 1955. 223 pp., 28 pls., 21 drawings. No price quoted.

55-9186

This is not a skin-diver's manual. It covers the whole history of underwater war, work, and acting. Strange as it may seem, there are still millions of treasure-trove on the sea bottom.

Doctors, Drums and Dances, by Andreas E. Laszlo; Hanover House, 575 Madison Ave., N. Y. 22. 1955. 284 pp., 50 photos. \$4.50

55-10511

In which an American physician from Connecticut takes his movie camera on a trip into the heart of Angola,—the spot on the west coast of Africa, just south of the Belgian Congo. More events to prove that one half of the world doesn't know how the other half lives.

Soil Sterilization, by W. J. C. Lawrence; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 169 pp., 34 figs., 14 tabs. \$4.25

How to sterilize soil from pint sized lots to acreage, the way the British do it.

Plant Ecology, by Wm. Leach; John Wiley & Co., 440 Fourth Ave., N. Y. 16. 1957. 106 pp., 6 figs.

Principles, practice and vegetation are studied in turn in this little Methuen book.

Teach Yourself Physiology, by A. David LeVay; Roy Publishers, 30 East 74th St., N. Y. 11. 1956. 208 pp., 43 figs. 1957.

56-5098

Another of those irreplaceable little manuals which cover the entire field without backtracking.

Hardiness of Plants, by J. Levitt; Academic Press, 111 Fifth Ave., N. Y. 3. 1956. 278 pp., 128 tabs., 37 figs. \$7.00

Vol 6 in the Agronomy Monographs Series, prepared under the auspices of the American Society of Agronomy, by Dr. Levis of the University of Missouri Department of Botany. There are 44 pages of references.

Puffins, by R. M. Lockley; Devin-Adair Co., 23 East 26th St., N. Y. 10. 1953. 186 pp., 16 pp. photos. \$4.00

We who have no chance to see puffins, except, perhaps, in rare visits to large zoological gardens, cannot help but enjoy these cheeky sea birds. The book is well supplied with ecological information and appendices.

Louisiana Birds, by Geo. H. Lowery, Jr.; Louisiana State Univ. Press, Baton Rouge 5, La. 1955. 556 pp., 27 2-color pl. 13 4-color pl. \$5.00

55-9351

As one who spent some time in 17 of the localities mentioned, the summarizer cannot speak too highly of the contents of this book.

Flora of Texas, by C. L. Lundell; University Press in Dallas, S. M. U. Dallas, Texas. 1955. 121 pp., 39 pls. \$5.00

The authors are evidently aware of the fact that whatever they do, any flora of Texas will be used as a flora for all the surrounding states. Specimens, and their collections are very well documented by counties.

Fossil Plants of the Florissant Beds, Colorado, by H. D. MacGinitie; Carnegie Institution of Washington, 1530 P St., Washington 5, D. C. 1953. 198 pp., 75 pls. \$5.25 paper, \$5.75 cloth

When Phi Sigma was first established, one of the first issues of THE BIOLOGIST carried an article by Mr. Erwine Hall Stewart of Epsilon Chapter, on this same subject. In the whirl of WW-I Stewart's article was forgotten, but the subject has finally been adequately handled.

Symposium on Inorganic Nitrogen Metabolism, ed. by W. D. McElroy and B. Glass; Johns Hopkins Press, Homewood, Baltimore 18, Md. 728 pp., tabs., figs., etc. \$10.00

55-12043

Records of 36 papers read at this symposium, June 21-23 1954, many of which had joint authorships. Seventy-three other scientists concerned with the function of molybdenum participated in the discussions, which were and related metals in the metabolism of both plants and animals.

Symposium on Chemical Basis of Heredity, ed. by W. D. McElroy and B. Glass; Johns Hopkins Press, Homewood, Baltimore 18, Md. 1957. 848 pp., tabs., figs., etc. \$12.50

55-7151

Thirty-eight papers and the discussion they stimulated, make up the weighty volume of the report. 127 other scientists participated in addition to those who read the original papers. The summary of the papers by Dr. Bentley Glass alone covers 77 pages.

Vertebrate Embryology, by Robert S. McEwen; Henry Holt & Co., 383 Madison Ave., N. Y. 17. 1957. 701 pp., 343 figs. \$6.50

* 57-5694

This is a fourth edition of a well and favorably known textbook which has lasted for thirty-four years. In the world of textbooks this should be some kind of a record.

Evolution: The Ages and Tomorrow, by G. M. McKinley; Ronald Press Co., 12 East 26th St., N. Y. 10. 1956. 275 pp. \$4.00

56-10927

The author owes his ideas to Giordana Bruno, to Spinoza, to Julian Huxley, H. G. Wells, G. G. Simpson and E. W. Sinnott, as well as to Oliver L. Riesen. From all of this we should conclude that his approach to evolution is scientific humanism and pantheism.

Plants in Action, by L. Machlis and J. G. Torrey; W. H. Freeman & Co., 660 Market St., San Francisco 4, Calif. 1956. 282 pp., 38 figs. \$3.75

Conspicuous for its freshness of approach and its unhackneyed material.

Plant Propagation, by J. P. Mahlstedt and E. S. Haber; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1957. 413 pp., figs. \$7.50

57-5924

This is an entirely new manual developed at Iowa State College, which came on the market this last Fall. It looks practical, might even be used for outside reading in freshman botany.

Psychology, Evolution and Sex, by C. P. Martin; Charles C. Thomas, Springfield, Ill. 1956. 166 pp. \$4.75

56-6396

This book seeks to draw attention to some criticisms which can be leveled at the mutation-selection theory. . . . The suggestion that lingering modifications deepen in time into segregating Mendelian factors is put forward not as an established fact, but as a theory which at the moment best explains the known facts and accords with the known evidence.

Amphibians and Reptiles of Georgia, by B. S. Martof; University of Georgia Press, Athens, Ga. 1956. 94 pp., 58 figs. \$2.00

A new key to the state's amphibians and reptiles by a member of the department of zoology at the state university.

Plant Virus Serology, by R. E. F. Matthews; Cambridge University Press, 32 East 57th St., N. Y. 22. 1957. 128 pp., 39 tabs., 12 figs., 6 pls. \$5.00

Dr. Matthews is with the plant diseases division of the Department of Scientific Investigation and Research at Auckland, New Zealand. His book covers much more than merely plant viri.

Animal Nutrition, by L. A. Maynard and J. K. Loosli; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 484 pp., figs. \$7.50

55-12109

Fourth edition of a well-known text which emanates from the School of Nutrition and the College of Agriculture at Cornell University.

Dictionary of Poisons, by I. and E. Mellan; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 150 pp., \$4.75

This would be a much more effective book if the "universal Antidote" which is frequently referred to were printed in it somewhere, preferably in large type. As it is we have not been able to find it.

Human Generation, ed. by Arthur W. Meyer; Stanford Univ. Press, Stanford, Calif. 1956. 1943. \$3.50

Classical excerpts from the writings of Karl F. Burdach, J. J. I. von Doellinger, Karl E. von Baer.

Soil Fertility, by C. E. Millar; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1955. 436 pp., 118 tabs, 54 figs. \$6.75

An entirely new book by the emeritus professor of soil science at Michigan State College. Accent is on the plant first, on its environment second, chemical constituents of food materials third, cropping systems next, and a survey of old field experiments ends the book.

General Zoology, by D. M. Miller and J. G. Haub; Henry Holt & Co., 383 Madison Ave., N. Y. 17. 1956. 550 pp., ills. \$6.50

This new book is the result of 20 years of teaching at Ohio State University. The authors have pitched over the old zoology textbook format, and subdivided their book in answer to four questions: What kind of animals? What relations have they to one another and their environment? How did they come into being? How do they maintain themselves?

Textbook of General Physiology, by Philip H. Mitchell; McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 36. 1956. 885 pp., 195 figs., \$10.50

A completely revised and reworked last edition, Dr. Mitchell having died shortly after he turned his manuscript over to the printers. He maintained the general purpose and the treatment of the four earlier editions, adding only the newer physiological developments which had come in subsequently.

Modern Biology, by T. J. Moon, P. B. Mann, J. H. Otto; Henry Holt & Co., 383 Madison, N. Y. 17. 1956. 755 pp., ills. \$4.88

This high school text has stood the test of time in a large school system. The present revised edition should warrant its continued use over an even longer period.

Principles of Zoology, by John A. Moore; Oxford University Press, 114 Fifth Ave., N. Y. 11. 1957. 667 pp., ills. \$7.50

Another new book, from the educational salt mines, with a flavor of Columbia, where the author has been teaching undergraduates at Barnard for the past 14 years. This is, definitely, a high-powered book, that should find a place in many a classroom, and on more reference shelves.

Kinships of Animals and Man, by Ann H. Morgan; McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 36. 1955. 839 pp., ills. \$6.75

Starting off at the very beginning, Dr. Morgan has kept first things first. She clearly lays down the fact that for every organism life is a concern of matter and energy. From there on, in logical progression, come states of matter, solutions, colloids, etc. until protoplasm is reached. It is pretty near time that someone got away from the "type" idea.

Boy's Book of Frogs, Toads and Salamanders, by Percy A. Morris; Ronald Press Co., 15 East 26th St., N. Y. 10. 1957. 240 pp., 75

figs. \$4.00

Like his "Book of Snakes" a few years back, Mr. Morris has kept his frogs, toads and salamanders at an interesting level which should stimulate study, interest and cultivation of the animals at home.

Physical Diagnosis, by W. R. Morrison and L. B. Chenoweth; Lea & Febiger, Washington Sq., Philadelphia, Pa. 1955. 412 pp., 208 figs. \$5.50

Fifth edition of a standard text for those who are responsible in public health programs, or for those who are in training for positions which may involve giving certain types of physical examinations.

Biographical Memoirs, by THE NATIONAL ACADEMY OF SCIENCES; Columbia University Press, N. Y. 27. 1956. 359 pp. \$4.00

Includes the obituaries of the following biologists: Charles E. Allen, George F. Atkinson, Douglas H. Campbell, Dennis R. Hoagland.

Science, Religion and Reality, ed. by Joseph Needham; George Braziller, Inc., 215 4th Ave., N. Y. 3. 1955. 355 pp. \$3.95

Originally published in 1925, these essays went out of print some time ago. When a reprinting was suggested George Sarton volunteered to write an introductory essay. It is 20 pages long. Together with the other essays it may be taken to represent the true relationship that is developing between science and religion.

Science and Civilization in China, Vol. II, by Joseph Needham; Cambridge University Press, 32 East 57th St., N. Y. 22. 1956. 696 pp., 12 ills., 11 tabs. \$14.50

This second volume continues what the "Manchester Guardian" calls the "greatest single act of historical synthesis and intercultural communication ever attempted by one man." It includes chapters on Confucianism, Taoism, fundamental ideas of Chinese science, the pseudo-sciences, Buddhist thought, human law and the laws of nature.

Laboratory Exercises in Horticulture, by H. E. Nichols and E. S. Haber; Iowa State College Press, Ames, Iowa. 1957. 121 pp., ills. \$2.25

Eighteen exercises of most practical application include lawn making and maintenance, propagation techniques, grape culture, core and stone fruit maintenance, disease control, small fruit, etc.

Biology of the Amphibia, by G. Kingsley Noble; Dover Publications, 920 Broadway, N. Y. 10. 1954. 577 pp., 174 figs. \$4.95

Dr. Noble died in 1940. This reprint of his chief publication will help fill in a vacant spot in new libraries and replace missing volumes in old ones.

Advances in Enzymology, Vol. 17, ed. by F. F. Nord; Interscience Publishers, 250 Fifth Ave., N. Y. 1. 1956. 556 pp., figs. \$11.00

Thirteen leaders in the field of Enzymology have contributed to this volume which is dedicated to the memory of James E. Sumner whose classic report on the crystallization of urease with the octohedral crystals started a controversy.

57-7484

55-9087

56-6057

56-7226

55-9548

56-6773

57-6028

55-6859

41-9213

Greenhouse Gardening, by H. and R. Northen; Ronald Press Co., 15 East 26th St., N. Y. 10. 1956. 353 pp., ills. \$6.50

56-10168

Anyone who can afford a greenhouse can afford this book. The rest of us can live in hopes, green-eyed. It is impossible to read this book and not be.

English Taste in Landscape, by H. V. S. and M. E. Ogden; University of Michigan Press, Ann Arbor, Mich. 1955. 224 pp., 165 ills. \$15.00

55-8649

This book belongs in the art collection as a part of the history of taste, not landscape. Its title indicates this, since in complete form it reads "English Taste in Landscape in the Seventeenth Century."

Medical Effects of The Atom Bomb, ed. by A. W. Oughterson and S. Warren; McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 36. 1956. 477 pp., tabs., figs., ills. \$8.00

Based on the results of the atomic bombing of Hiroshima and Nagasaki, this book gives about all the pertinent data any ordinary library might want to have available on the subject.

Modern Methods of Plant Analysis (Vol. 1-), ed. by K. Paecs and M. V. Tracey; Springer Pub. Co., 44 East 23rd St., N. Y. 10. 1956. 542 pp., 215 figs. \$20.55

The uncertain peace is bringing back the old multilingual scientific publications which were becoming so common between the wars. This volume is the first in a four-volume series which can still be ordered at the pre-publication price of \$95.40, every cent of which it will be worth.

Wild Flowers of California, by M. E. Parsons; California Academy of Sciences, Golden Gate Park, San Francisco, Cal. 1955. 421 pp. \$3.95

Begun in 1897 by William Doxey, this book has gone through five editions. The present author, a native Chicagoan, has sponsored the last four. The book is arranged by flower colors through white, yellow, pink, blue-purple, red. There are indices to English, Latin, and to technical terms. It might speed up the interest of the tourists users if there was also an index of the old Spanish plant names too.

The Singing Wilderness, by S. F. Olson; Alfred A. Knopf, 501 Madison, N. Y. 10. 1956. 245 pp. ills. \$4.00

55-9290

Around the year with a man who writes poetic prose without rhyme or rhythm, and devotes it all to that wilderness of rock, woods, air and water, which lies along the border northwest of Lake Superior.

Amphibians and Reptiles, by J. A. Oliver; D. Van Nostrand, Princeton, N. J. 1955. 359 pp., 74 figs. \$6.95

55-10534

Discusses folklore, economic values, classification, location and movements, activity, relation to environment, food and feeding, reproduction, growth and longevity, as pets.

Study of Plant Communities, by H. J. Oosting; W. H. Freeman & Co., 660 Market, San Francisco 4. Calif. 1956. 448 pp., 193 figs. \$6.00

This second edition tries to keep up with the snow-balling literature in the field of plant ecology. Succession and climax have had to be redone to accommodate the monocl原因 and the polyclimax theories.

56-11029

Cellulose and Cellulose Derivatives, Vol. V, ed. by E. Ott and H. M. Spurlin; Interscience Publishers, 250 Fifth Ave., N. Y. 1. 1955. 544 pp., tabs., figs. \$12.00

53-7161

This volume covers part 3, physical properties of cellulose and derivatives in solution, mechanical properties, tests for cellulose and derivatives, and eight appendices.

Experimental Psychology, by I. Pavlov; Philosophical Library, 15 East 40th St., N. Y. 16. 1957. 653 pp., 4 pls. \$7.50

Reprint of the great Russian psychologist's main work, and some other essays as well as his own autobiography.

Insect Pests of Farm, Garden and Orchard, by L. M. Peairs and R. H. Davidson; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1956. 661 pp., 577 figs. \$8.50

56-6485

After the death of the senior author his collaborator, Dr. Davidson of the Ohio State faculty, carried the work of this fifth edition on to completion. Many new insects have become pests since 1941.

Wild America, by R. T. Peterson and J. Fisher; Houghton Mifflin Co., 2 Park St., Boston Mass. 1955. 434 pp., ills. \$5.00

55-8876

A tour of the U.S.A. by two naturalist editors, one British, the other American, from Boston down the east side and around Florida, then west along the Gulf, up the west coast to Anchorage and the Pribilofs, the Aleutians, and then by plane back to New York.

Ornithology, by O. S. Pettingill; Burgess Pub. Co., 426 So. 6th St., Minneapolis 15, Minn. 1956. 379 pp., 23 pls., 180 ills. \$5.00.

In its third edition the Pettengill lab manual has blossomed out into a 8½ x 11 in. photo offset field record, as well as guide.

Classics of Biology, by August P. Sunyer; Philosophical Library, 15 East 40th St., N. Y. 16. 1955. 337 pp.

Sixteen chapters of quotations, from one to twenty paragraphs long, from pioneers in the various biological fields.

Reptile World, by Clifford H. Pope; Alfred A. Knopf, 501 Madison, N. Y. 22. 1955. 335 pp., 230 ills. \$7.50

54-12979

Although designed as a popular survey of the reptant world for the layman, it is complete enough to direct a person at least to the more specific world areas and their indigenous types.

How to Know the Fresh-Water Algae, by G. W. Prescott; Wm. C. Brown Co., Dubuque, Ia. 1954. 211 pp., 331 figs. \$2.00 spiral, \$2.75 cloth bound.

The H. E. Jaques "How To Know" series of spiral bound manuals has finally got down again to the algae. This issue could not have found a more capable editor.

Photosynthesis and Related Processes, by E. I. Rabinowitch; Interscience Publishers, 250 Fifth Ave., N. Y. 1. 1956. 877 pp., figs. \$16.50

45-7293
Kinetics of photosynthesis, pigment factor, time effects,—induction phenomena, and intermittent light, photochemistry of chlorophyll in vitro and in vivo, chemical path of carbon dioxide reduction, miscellaneous other problems.

American Water and Game Birds, by A. L. Rand; E. P. Dutton & Co., 300 Fourth Ave., N. Y. 10. 1956. 239 pp., 127 pl. in col., 40 photos, 35 silhouettes. \$11.50

56-8246
This book would be a "buy" at any price. There is nothing in the book market along the biological line today that can equal the beauty of its color-work, or the artistry of its black-and-white photography, or its delicate silhouette work (which has all the flair for line and mass of some old Japanese print). The author is curator of zoology at the Chicago Natural History Museum.

Genus *Lysimachia* in the New World, by J. D. Ray; University of Illinois Press, Urbana, Ill. 1956. 160 pp., 20 pls., 11 maps. \$2.50

54-9664
Ed.: No comment.

The Vertebrate Body (Shorter Version, by A. S. Romer; W. B. Saunders Co., 219 W. Washington Sq., Philadelphia 5, Pa. 1956. 486 pp. 390 figs. \$5.50

56-5089
This is no new work. The author is frank to admit that it is merely abbreviation of the longer work for the benefit of those who wish a shorter textbook to fit their courses.

Drop Protection, by G. J. Rose; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 223 pp., 113 ill. \$10.00

No one who reads this British book is going to lay it down with the idea that our overseas friends are horticulturally "backward." We may not have molecrickets, but we do have our miseries, and therefore it is interesting to note that we also have company.

Rosenau's Preventive Medicine and Public Health, ed. by K. F. Maxcy; Appleton-Century-Crofts, 35 W. 32nd St., N. Y. 1. 1956. 1465 pp., figs., col. pls.

56-9779
This is the eighth edition of a standard work, which, however, has grown with the times. Signed articles have been contributed by 26 outstanding medical or public health authorities.

Textbook of Entomology, by H. H. Ross; John Wiley & Sons; 440 Fourth Ave., N. Y. 16. 1956. 519 pp., 402 ill. \$7.75

56-9827
Eight years after its first edition appeared this second edition is called for, thus affording place for more recent data on physiology, new keys to the order of insects, ecological population dynamics, evolutionary material arthropods, and several new drawings.

Uranium and Other Miracle Metals, by Fred Reinfeld; Sterling Publishing Co., 215 East 37th St., N. Y. 16. 1955. 128 pp., ill. \$3.50

55-10378
Apparently no one has as yet connected up the presence of uranium with any plant indicators (which was why we asked the publishers of this fine book for a chance to see it).

Botany, by W. W. Robbins, T. E. Weter, C. R. Stocking; John Wiley & Sons, 440 4th Ave., N. Y. 16. 1957. 578 pp., ill. \$6.95

57-5930
The original edition appeared only seven years ago. That in this short time this very successful manual should need revision and reprinting is a tribute to its authors and their far-sighted policy of writing the book for the student of today, as he is.

Dahlak, by G. Roghi and F. Baschieri; Essential Books, 16-00 Pollitt Drive, Fair Lawn, N. J. 1957. 280 pp., 40 b&w ill., 11 in col. \$6.00

Originally written in Italian, the Priscilla Hastings translation is so natural that one forgets the chief actors' nationality. It is the story of the Italian National Underwater Expedition in the Red Sea. These are skin-divers at work.

Police Drugs, by Jean Rolin; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 194 pp. \$4.75

The use of any narcotic like Sodium Pentothal, to induce confessions of crimes is here taken over the coals in no uncertain fashion.

Osteology of the Reptiles, by Sherwood Romer; Univ. of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill. 1956. 772 pp., 247 figs. \$20.00

55-5143
This has been well called the "definitive work" on reptile osteology. It brings together data that have hitherto been too widely separated.

Life, The Great Adventure, by Jean Rostand and Paul Bodin; Charles Scribner's Sons. 597 Fifth Ave., N. Y. 17. 1956. 228 pp., \$3.50

56-7130
Polite "brain-washing" of a not-unwilling and famous victim, Jean Rostand, litterateur and scientist, by a psychologist turned war-correspondent, Paul Bodin. Interesting, if true.

Fleas, Flukes and Cuckoos, by M. Rothschild and T. Clay; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1957. 305 pp., 99 b&w photos, 4 maps, 22 figs. \$5.00

Two bird parasitologists here disclose some of the skeletons in the avian cupboards. The rather amoral habit of cuckoos pitching other bird's eggs out of nests and laying their own eggs in their place would not only seem to be a colossal piece of avian imposition but also afford a chance for other forms of life to parasitize the unfortunate foster parents.

Dissection Guides, by H. G. O. Rowett; Rinehart & Co., 232 Madison Ave., N. Y. 16. 1957.

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|-----------------------|------------------------|
| 1. The Frog | 63 pp., 65 figs. \$9.5 |
| 2. The Dogfish | 62 pp., 64 figs. .95 |
| 3. The Rat | 64 pp., 93 figs. .95 |
| 4. The Rabbit | 32 pp., 48 figs. .95 |
| 5. Invertebrata | 56 pp., 81 figs. .95 |

Probably something one could give to an interested amateur, or to a green instructor so he'd know what to look for in the lab period. Invertebrata include the earthworm. The crayfish, the cockroach, the lancelet, the swan mussel, and the snail.

Atomic Energy for Medical Officers, by Royal Naval Medical School Staff; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 169 pp., 12 pl., figs. \$4.75

Pocket-sized military manual for medical officers, boiled down, clarified to the point

where atomic energy is understandable.

Cellular Mechanisms in Differentiation and Growth, ed. by D. Rudnick; Princeton University Press, Princeton, N. J. 236 pp., pls., tabs., figs. \$7.50

56-10678

14th symposium on the study of development and growth papers by Delbrueck, Swift, Manton, Tartar, Lederberg, Sussman, Niu, Wetmore, Hamburger, Ben Geren, and Billingham. Both botanical and animal materials were used and discussed.

Aspects of Synthesis and Order in Growth, ed. by E. Rurnick; Princeton University Press, Princeton, N. J. 1955. 274 pp., pls., tabs., figs. \$6.00

55-10678

13th symposium on development and growth papers by Pauling, Fruton, Stanier, Ebert, Russell, Cohen, Hendricks and Borthwick, Emerson, Spratt, Grobstein, and Bodenstein.

Rutherford, by John Rowland; Philosophical Library, 10 East 40th St., N. Y. 16. 1957. 160 pp., ill. \$4.75

Twenty-five years ago Lord Rutherford announced the splitting of the first atoms, when lithium and hydrogen united and then split to form two atoms of helium. This story and many more illuminates the Rowland book. No biologist can afford to let his education exclude a knowledge of the great accomplishments of men like Rutherford.

Six Wings, by George Sarton; Indiana Univ. Press, Bloomington, Ind. 1957. 318 pp., 30 pls., \$6.75

56-11998

Patten Lectures for 1955 at the University of Indiana, were given by Dr. George Sarton. He chose as his theme the six Old Testament "wings," and divided them up as: geography and education; mathematics and astronomy; physics, chemistry and technology; natural history; anatomy and medicine; and a final lecture on Leonardo da Vinci, who summed up the best in art, science, beauty and truth.

Ancient and Mediaeval Science During the Renaissance, by George Sarton; Univ. of Pennsylvania Press. 3436 Walnut St., Philadelphia 4, Pa. 1955. 233 pp., \$5.00

54-11538

The Rosenbach Lectures and the American Philosophical Society Lecture in Philadelphia, 1953, are here printed together as annotated and extended by their author. They cover medicine, natural history, mathematics and astronomy.

Biology of Spiders, by T. H. Savory; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 376 pp., 121 figs., 16 pls. \$4.00

Anatomy, physiology, ecology and evolution of spiders in detail.

Human Heredity Handbook, by A. Scheinfeld; J. B. Lippincott Co., East Washington Sq., Philadelphia, Pa. 276 pp., ill. \$3.95

56-5361

This is the author's "You and Heredity" boiled down and made palatable to newlyweds and expectant mothers. He hasn't left much out, and made it all available for quick reference.

Procedure in Taxonomy, by E. T. Schenk and J. H. McMasters; Stanford University Press, Stanford, Calif. 1956. 119 pp., \$3.50

This is the zoological side of the taxonomic problem, giving as it does the rules and the practises in establishing new or validating old animal nomenclature.

Book of Poisons, by G. Schenk; Rinehart & Co., 232 Madison Ave., N. Y. 16. 1955. 310 pp. \$5.00

55-11017

From the German of Martin Bullok, who has long been an experimenter on himself with the various poisonous plants, etc.

Skin Diver's and Spearrfisherman's Guide, by H. Schenck, Jr.; Cornell Maritime Press, Cambridge, Md. 1955. 58 pp., ill., maps. \$1.75

55-10161

Handy paper-covered guide to the salt-water areas which addicts may find exciting game, and gamy excitement. Around many of the reduced sections of U.S.C. & G. Survey sectional maps there often appears the tell-tale "MANY WRECKS IN THIS AREA!"

Healthier Living, by Julius Schiffers; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1954. 928 pp., ill. \$5.75

54-12593

The best health and hygiene book that this old teacher of biology has laid his hands on in years. Its attitude is always positive, a type of psychology this world needs a lot of, these days.

All About Aquariums, by Earl Schneider; Garden City Books, 575 Madison Ave., N. Y. 22. 1956. 128 pp., ill. \$1.75

Bed-rock attention to aquarium details, no time wasted on the fish, which should logically, come later anyway. Worth having around.

All About Breeding Tropical Fishes, by Earl Schneider; Garden City Books, 575 Madison Ave., N. Y. 22. 1956. 128 pp. \$1.75

A thoroughly scientific and common sense treatment of a prosaic subject which has suffered from overenthusiastic hobbyists.

Amateur Beekeeping, by E. L. Sechrist; Devin Adair Co., 23 East 26th St., N. Y. 10. 1955. 148 pp., 15 figs., \$3.50

55-11865

Written in non-technical language, therefore not only readable, but interesting.

Flowerless Plants, by D. H. Scott and C. T. Ingold; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1955. 170 pp., 128 figs. \$2.75

Mosses, ferns, liverworts, algae and bacteria are here treated by themselves.

Flowering Plants, by D. H. Scott and F. T. Brooks; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1948. 274 pp., 117 ill. \$1.75

Not to be regarded as a manual of botany in general, but as an introduction to structural botany. The authors believe that some parts of the book will not be followed without close attention. They quaintly believe that science, if it is to be taken seriously, should require as much brain usage as algebra or grammar.

E. A. Birge, by G. C. Sellery; University of Wisconsin Press. 811 State St., Madison, Wis. 1956. 221 pp., \$3.50

56-9305

This is a memoir written by one of President Birge's intimate friends, one with a sly

twinkle in his eyes. If he can't paint the whole picture of Wisconsin's ex-president, at least he will give us a fairly accurate portrait of not only Dr. Birge but all the price-less group who used to associate together on and off the Wisconsin campus.

Electrochemistry in Biology and Medicine, ed. by T. Shedlovsky; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1955. 369 pp., illus., figs., etc. \$10.50

55-8561

In 1953 a symposium was held in New York, during the meetings of the Electrochemical Society. Among those present were Hitchcock, Scatchard, Sollner, Schmitt, Cole, Grundfest, Nachmansohn, Blinks, Osterhout, Longworth, Tanford, Carr., Snell, Miller, Johnston, Bagchi, and Jasper.

Practical Horticulture, by J. S. Shoemaker and B. J. E. Teskey; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1955. 374 pp., 129 figs. \$4.20

55-7960

This is a new text, written for students of vocational agriculture, and for gardeners. Its aim therefore is to make its instructions simple, practical and easy to follow. Both of the authors are members of the Ontario Agricultural College, Guelph, Ontario.

Your Heart and Vitamin E, by Drs. E. and W. Shute; Devin-Adair Co., 23 East 26th St., N. Y. 10. 1956. 137 pp. \$3.00

The Cardiac Society of 656 Book Bldg., Detroit, here presents the case for alphatocopherol, (Vitamin E) in the war on all forms of heart weakness.

Life, by G. G. Simpson, C. S. Pittendrigh, L. H. Tiffany; Harcourt Brace & Co., 383 Madison, N. Y. 17. 1957. 864 pp., illus., \$7.50

Another new book for general biology by professors from Columbia, Princeton and Northwestern Universities. The authors have strong convictions that there is such a thing as general biology, and not a shotgun marriage between botany and zoology. With all the high-powered help they have had, it looks as if they have something here.

Botany, by E. W. Sinnott and K. S. Wilson; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 528 pp., pls., figs. \$6.75

54-8807

This fifth edition of Sinnott's original text of 1923, marks a wide divergence in attention to various scientific disciplines in the past third of a century. Out of the wealth of available material the authors have chosen wisely. We would be much inclined to have students get acquainted with the last chapter, "Botany and the Future," first, as an integrating principle.

Biology of the Laboratory Mouse, ed. by G. D. Snell; Dover Publications, 920 Broadway, N. Y. 10. 1956. 497 pp., 172 figs. incl. 128 photos. \$6.00

Originally copyrighted in 1941, this new edition is an unabridged reprint of the original first edition.

Anatomy of The Honey Bee, by R. E. Snodgrass; Cornell Univ. Press, 124 Roberts Pl., Ithaca, N. Y. 1956. 334 pp., 107 figs. \$6.00

A completely new account of the anatomy of the honey bee, written by a collaborator at the Smithsonian Institution and the U. S. D. A. Due to the increasing amount of physio-

logical work others are doing on the bees, this author restricts this work closely to the anatomy of the bee.

Handbook of Biological Data, ed. by W. S. Spector; W. B. Saunders Co., West Washington Sq., Philadelphia 5, Pa. 1956. 584 pp., \$7.50

56-13410

This is the handbook prepared under the direction of the Division of Biology and Agriculture, The National Academy of Sciences, The National Research Council. It should, of course, be in every biological library.

Polysaccharides in Biology, ed. by G. F. Springer; Josiah Macy, Jr. Foundation. 16 West 46th St., N. Y. 36. 1956. 271 pp., 30 figs., 22 tabs. \$5.00

56-9174

This first conference on Polysaccharides divided up into four areas: problems of communication, of classification, bacterial polysaccharides, and, blood group substances.

Bacterial Anatomy, ed. by E. T. C. Spooner and B. A. D. Stocker; Cambridge Univ. Press. 32 East 57th St., N. Y. 22. 1956. 360 pp., 21 pls., figs., etc. \$6.00

Preliminary volume to the discussions held last April in London. Articles submitted cover, among others, bacterial cellular organization, flagella, capsules, cell walls, protoplasts, osmotic function, chromatin, chromosomes, cytoplasm, inclusions, long form structure.

Chlorococcum Meneghini, by R. C. Starr; Indiana Univ. Press, Bloomington, Ind. 1955. 111 pp., 239 figs. \$3.00

Full title of this paper is "A Comparative Study of *Chlorococcum Meneghini* and other Spherical, Zoospore-Producing Genera of the Chlorococcales." Algologists, particularly chlorococcolgists, please note.

Birds of Australia, by Lyla Stevens; Albert Daub & Co., 257 Fourth Ave., N. Y. 10. 1957. 61 pp., 28 illus. \$3.75

Twenty-eight birds from Australia are figured here. The number that could have been figured would run into many times this slender volume's quota. We missed above all the Galah, with his roseate breast and head, and dove-gray back wings and tail.

Laboratory Manual of Microbiology, by H. M. Steward; C. V. Mosby Co., St. Louis, Mo. 1957. 103 pp. \$2.25

Second edition of a manual much used in training schools for nurses, and public health workers. Newer means of destroying or inhibiting organisms are discussed.

Individual and Community Health, by W. W. Stiles; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1953. 492 pp., 131 figs., 32 tabs.

52-5624

Although this book came out four years ago, it still continues to gather favorable comments from its users, not the least of which are for its high level of social consciousness.

Handbook of Histology, by K. A. Stiles; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 240 pp., 10 tabs., 31 illus. \$3.00

56-9639

Fourth edition of much mole inconveniently titled manual, now includes new chapter on interpreting sections, another on the macrophage system, and other new sections.

Web of Life, by J. H. Storer; Devin-Adair Co., 23 East 26th St., N. Y. 10. 1954. 144 pp. 48 pls. \$3.00

53-12063

First appeared in 1953 and immediately ran thru three printings. A first book of ecology that rather definitely slants toward conservation. Good in text and superb photographs.

Web of Life,— (Same book, Signet Key Series, paper covered, 35 cents)

Green Thumb Without Aching Back, by Ruth Stout; Exposition Press, 386 Fourth Ave., N. Y. 16. 1955. 164 pp. \$2.75

55-10304

This is one of those dizzy books by a female who does all sorts of things in a garden and, you guessed it, if she has been doing them long enough they come out all right. She has almost as much humor as the author of "The Egg and I," but is a lot more refined.

Skin Diving and Exploring Underwater, by John Sweeney; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1955. 176 pp., 8 pls. \$3.50

55-6870

Utilitarian as this book is, it is also an extraordinarily fine piece of propaganda for skin diving as a hobby.

Forest Entomology in Hawaii, by Otto H. Swezey; Bernice P. Bishop Museum, Honolulu 35, Hawaii. 1954. 266 pp., 32 figs.

The fauna of tropical trees is not like our insect tree population, hostile to the hosts. These insects are, shall we say, commensals?

Illustrated History of Science, by F. Sherwood Taylor; Frederick A. Praeger, 105 West 40th St., N. Y. 18. 1955. 178 pp., 120 figs. \$5.00

55-10589

The 1952 Royal Institution lectures by Taylor as illustrated by A. R. Thomson of the Royal Academy. It's hard not to learn history this way.

Deer of North America, ed. by W. P. Taylor; Stackpole Co., Telegraph Press Bldg., Harrisburg, Pa. 1956. 668 pp., 39 pls. \$12.50

Sixteen authors cooperate in producing a fine, fat volume. They are state game administrators, U.S.F. & W.L.S. biologists, Forest Service authorities, educators and practical scientists. There hasn't been anything like this done in nearly a half century.

General Botany, by W. T. Taylor and R. J. Weber; D. Van Nostrand Co., 120 Alexander St., Princeton, N. J. 1956. 376 pp., ills. \$5.75

56-8223

The most unusual botanical text to appear in years. Functional in treatment, excitingly illustrated, convenient in size,— is this our hope for a new approach to botany?

Plant Physiology, by Meirion Thomas; Philosophical Library, 15 East 40th St., N. Y. 16. 1956. 692 pp., 89 ills. \$12.00

Written with collaboration of two other lecturers in the University of Durham, at King's College, Newcastle upon Tyne, it might at first glance pass for a plant biochemistry. The conduction of water theories reviewed are stimulating.

Bird Life, by Niko Tinbergen; Oxford Univ.

Press, 114 Fifth Ave., N. Y. 11. 1954. 63 pp., ills., 2 pls., 1 in color. \$2.75

A fine gift for a bird-watching friend. Answers lots of questions as to the "Why's" of bird behavior.

Current Anthropology, ed. by William L. Thomas, Jr.; University of Chicago Press. 5750 Ellis Ave., Chicago 37, Ill. 1956. 377 pp. \$3.50

56-7961

Seventeen signed articles led off by Julian S. Huxley. Is intended as a supplement to "Anthropology Today."

Learning and Instinct in Animals, by W. H. Thorpe; Harvard University Press, Cambridge, Mass. 1956. 493 pp., 71 figs., 9 pls. \$10.00

Thorpe is a Fellow of Jesus College, Cambridge, and Lecturer in the University. Has a 40-page bibliography.

Iowa's Water Resources, ed. by J. F. Timmons, J. C. O'Bryne and R. K. Flevert; Iowa State College Press, Ames, Iowa. 1956. 225 pp., \$3.00

56-12106

First full and accurate estimate of its water resources and their future.

Soil Fertility and Fertilizers, by S. J. Tisdale and W. L. Nelson; Macmillan Co., 60 Fifth Ave., N. Y. 11. 430 pp., figs., pls. \$7.75

56-8585

A calmly objective study of all kinds of fertilizers and what results to expect from using them.

Introduction to Climate, by G. T. Trewartha; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1954. 402 pp., figs., maps. \$7.00

53-12438

This is the 3rd edition of a by-now standard textbook on climatology. It has been considerably improved over its predecessors.

Peaceful Uses of Atomic Energy, by the U.N. Vol. 10: Radioactive Isotopes and Nuclear Radiation in Medicine; 544 pp., figs., tabs. \$8.00

Vol. 11: Biological Effects of Radiation, 402 pp., figs., tabs. \$8.00;

Vol. 12: Radioactive Isotopes, and Ionizing Radiations in Agriculture, Physiology and Biochemistry, 553 pp., figs., tabs., \$9.00

Vol. 16: Record of the Conference, 203 pp., figs., tabs., \$5.00

These are the parts of the 1955 International Conference on Atomic Energy, held in Geneva, which would be of particular value in a biological library. What those values might possibly be can only be determined by close study of this tremendous wealth of material.

Principles of Embryology, by C. H. Waddington; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 510 pp., ills. \$7.50

Perhaps the most novel feature of this book on the developmental processes is the way in which experimental embryology and genetics are brought together.

Plant Pathology, by J. C. Walker; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1957. 707 pp., 194 figs., 3 tabs. \$10.00

56-10335

Comprehensive treatments of better-known diseases. Includes a chapter on the history of plant pathology, also on environmental factors, host-parasitic relations, and methods of

disease control. This is the second edition of a much-used book which originally appeared only seven years ago.

Genesis of The Rat Skeleton, by D. G. Walker and Z. T. Wirtschafter; Chas. C. Thomas, 301-327 East Lawrence Ave., Springfield, Ill. 1957. 59 pp. \$7.50

No biology department where comparative anatomy or embryology is studied should be without this gloriously different type of atlas. Spirally bound with metal strips, it stands 12 inches high, by 13 inches long and opens like a laboratory chart. Each page has from one to many photographs or x-ray pictures, beginning with the start of ossification centers, 18 days after conception, and carrying through until ossification is complete at 31 days of age, or 53 days after conception.

Corn and Its Early Fathers, by Henry A. Wallace and W. L. Brown; Michigan State Univ. Press, East Lansing, Mich. 1956. 134 pp., 27 figs. \$3.75

This book is appropriately published at Michigan State College, where W. J. Beal was a member of the Botany staff during the days of Charles Darwin. Having read the latter's book on the effects of cross and self fertilization in the vegetable kingdom, Beal got in touch with Darwin, and tried it out on corn at Lansing, producing the first scientific hybrids of corn. The co-author of this work is the former Vice-president of the U. S. A.

Physical Chemistry, by S. C. Wallwork; Longmans, Green & Co., 55 Fifth Ave., N. Y. 3. 1956. 307 pp., 44 figs. \$4.75

Beginning with a chapter on mathematics needed in this course, the book contains chapters on properties of matter, the structure of atoms, the structure of molecules, chemical reaction, properties of solutions, electrolytic dissociation, electrochemical cells, acids and bases, surface chemistry, colloids.

Botany, by Paul Weatherwax; W. B. Saunders Co., West Washington Sq., Philadelphia 5, Pa. 1956. 509 pp., 305 figs. \$5.75

First 22 chapters cover all the author offers on general botanical principles. Chapters 23 to 33 deal with the phylogenetic aspects of the plant kingdom. This is the 3rd edition in 15 years. Designed for a one-semester course.

Biology, by Paul Weisz; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1954. 679 pp., figs. \$6.50

This is another entirely new text. It is divided into three levels, of which the first is a more or less condensed summary of the entire book. The second level expands the first. The third level, five times as long as the second, and nearly forty times as long as the first expands it most fully.

Grasslands of The Great Plains, by J. E. Weaver and F. W. Albertson; Johnsen Pub. Co., 1135 R St., Lincoln 8, Nebr. 1956. 395 pp., 92 figs. \$6.00

Here is a study of the prairie that stretches 2,560 miles north and south, and nearly 400 miles east and west. It also studies not only the grasses above the soil but also their growth down under it. The forbs are not neglected.

Botany, by T. E. Weier, C. R. Stocking, J. M. Tucker; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1957. 175 pp., charts.

A laboratory manual of some 57 exercises affording an unusually complete survey of the botanical field.

Birds and Men, by Robert H. Welker; Harvard University Press, Cambridge, Mass. 1955. 230 pp., 40 figs. \$5.75

One of the earlier works issued by the new Belknap Press of the Harvard U. Press, this book has a larger than usual share of nostalgic reminiscence in it. Subtitled, "American Birds in Science, Art, Literature and Conservation," the book is a store-house of avian legend and tradition.

General Biology, by H. and P. H. Wells; McGraw-Hill Book Co., 330 West 42nd St., N. Y. 36. 1956. 520 pp., 300 figs. \$6.50

Here is another new book with a message. Divided into four parts, the first is "basic," the second is "the living world," the third is "comparative," and the fourth is "social biology." The senior editor is a professor of science education.

Plant Propagation Practises, by James S. Wells; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1955. 344 pp., 53 figs. \$7.50

Written especially for young nurserymen. Tells exactly how to set up a propagating unit. How to equip it. Then how to go about propagating living plants.

Biochemical Preparations, Vol. 4, ed. by W. W. Westerfield; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 108 pp. \$3.75

Twenty-one compounds and how to prepare them.

Biophysical Chemistry, by E. S. West; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 399 pp., 40 figs. \$7.00

Previously known as "Physical Chemistry for Students of Biochemistry and Medicine." Effort is made to demonstrate physical-chemical principles in operation.

Native Trees of Florida, by E. West and L. E. Arnold; Univ. of Florida Press, Gainesville, Fla. 1956. 218 pp., 207 pls. \$4.50

After five reprintings of the original 1946 edition, this represents the first revised edition of 1956. Stabilization in botanical nomenclature would have necessitated this, but six new species native to the state also weighed in on the new edition.

Trout Flies, Natural and Imitations, by C. M. Wetzel; Stackpole Co., Telegraph Press Bldg., Harrisburg, Pa. 1955. 152 pp., 28 pls. \$5.00

Apparently Entomology is getting some avid recruits among the fly-tying fraternity.

Future of Arid Lands, ed. by Gilbert F. White; American Association for the Advancement of Science, 1515 Mass. Ave., N. W., Washington 5, D. C. 1956. 453 pp. \$6.75

From the International Arid Lands Meetings come these 17 papers from as many interested people. Some interesting suggestions came, too. Like breeding arid land plants to grow and produce in such locations.

Analysis of Soils, etc., by S. A. Wilde and G. K. Voigt; J. Edwards, Ann Arbor, Mich. 1955. 117 pp., 45 figs. \$3.75

55-7857

Whole title is "Analysis of Soils and Plants for Foresters and Horticulturists." A small manual for those who are not content with commercially advertised soil testing kits.

First One Hundred and Fifty Years, by Wiley; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1957. 242 pp., ill. \$7.50

57-7626

Twenty-eight articles about the John Wiley & Sons firm in its first 150 years.

Biochemical Individuality, by Roger J. Williams; John Wiley & Sons, 440 Fourth Ave., N. Y. 16. 1956. 214 pp., 17 figs. \$5.75

56-12578

First work to collect and attempt to interpret the accumulating data on inter-individual biochemical variations.

Biochemistry of Vitamin B12, ed. by R. T. Williams; Cambridge University Press, 32 East 57th St., N. Y. 22. 1955. 123 pp., tabs. \$3.75

Eight papers by eleven British research workers given at a symposium held in the London School of Hygiene and Tropical Medicine in February, 1955

Botany, by C. L. Wilson and W. E. Loomis; Dryden Press, 31 West 54th St., N. Y. 19. 1957. 528 pp., ill. \$7.25

57-8839

Among new topics added are: tillering in cereals, plant cell walls, mycorrhizae, air-layering, speciation, slime molds, life-cycle in *Vaucheria*, convergent evolution, and 106 new illustrations.

Natural History of Birds, by L. W. Wing; Rinald Press, 15 East 26th St., N. Y. 10. 1956. 539 pp., figs. \$6.75

56-11291

Much more than a guide to ornithology, this book comes as close to a good bird encyclopedia as one could wish. There are 24 chapters covering not only morphology, embryology, physiology and ecology, but also evolution, flight, migration, song, heredity, protection, economic relations and bird study.

Educators Guide to Free Tapes, Scripts and Transcriptions, by W. A. Wittich and G. H. Halsted; Educators Progress Service, Randolph, Wis. 1957. 184 pp. \$5.75

A good investment for the audio-visual minded teacher.

The Earthworm; The Frog; The Human; by Albert Wolfson; Row, Peterson & Co., Evanston, Ill. \$3.20 each

Transparent plastic sheets with the organs done in colors on both sides. They must be seen to be appreciated.

Garden Encyclopedia, ed. by E. L. D. Seymour; Wm. H. Wise & Co., 50 W. 47th St., N. Y. 36. 1956. 1380 pp., ill. \$6.40

This is a lot of book for the price. There is hardly a garden problem which one can't find solved, if he is patient enough, and gets familiar with the book soon enough.

Development of Vertebrates, by Emil Witschi; W. B. Saunders Co., West Washington Sq., Philadelphia 5, Pa. 1956. 588 pp., 370 figs. \$8.50

56-5835
A book for the comparative embryology course which includes the fertilization, and development processes in amphibia, fishes, birds and mammals.

Pharmacopoea Internationalis, Vol. 2; World Health Organization, Palais des Nations, Geneva. 1955. 350 pp. \$6.75

217 monographs, 26 appendices, 1 annex. Includes new specifications of new pharmaceuticals, monographs on compressed tablets, sterile injections, and tinctures noted in Vol. 1.

Rauwolfia, by R. T. Woodson, H. W. Younken, E. Schlittler and J. A. Schneider; Little Brown & Co., 34 Beacon St., Boston 6, Mass. 1957. 149 pp., 25 figs. \$5.50

56-10610

Until last January no book was available to give all the background details of the botany, pharmacognosy, chemistry or pharmacology of the remarkable plant, *Rauwolfia*, from which modern tranquilizers are being derived.

Plant Propagation and Garden Practise, by R. C. M. Wright; Criterion Books, 100 Fifth Ave., N. Y. 11. 1956. 192 pp., 22 pls. \$4.50

56-6207

With a preface by the Curator of the National Botanic Garden Glasnevin, Dublin, this book has some of the best technique illustrations that have yet appeared in garden literature.

Ground Cover Plants, by D. Wyman; Macmillan Co., 60 Fifth Ave., N. Y. 11. 1956. 175 pp., 41 pls., 8 figs. \$4.75

56-7340

For many years Horticulturist at the Arnold Arboretum of Harvard, Wyman's advice never loads anyone astray, particularly if the hardiness zones (inside each cover) and the type of soils needed are kept in mind.

Biologic Effects of Tobacco, ed. by E. L. Wynder; Little, Brown & Co., 34 Beacon St., Boston 6, Mass. 1955. 215 pp., 20 figs., 7 tabs. \$4.50

55-8605

Here is a critical analysis of both clinical and experimental aspects of the effects of smoking. Some of the illustrations will NOT appear in tobacco ads.

Introduction to Biological Science, by C. W. Young, G. L. Stebbins and F. G. Brooks; Harper & Bros., 49 East 33rd St., N. Y. 16. 1956. 555 pp., 243 figs. \$4.75

56-6099

A new short-course in general biology based on and emphasizing the human organism.

Seashores, by H. S. Zim and L. Ingle; Simon & Schuster, Rockefeller Center, N. Y. 20. 1955. 160 pp., 475 ill. \$1.95 in cloth; \$1.00 in paper.

Written by Dr. Zim of Illinois, sponsored by the Wildlife Management Institute, published by Simon & Schuster, the Golden Nature Guides, of which this is a sample, should all be on sale in every college bookstore.

Ustilaginales of the World, by G. L. Zundel; Pennsylvania State College, State College, Pa. 1953. 410 pp., 3 pls. \$3.50 paper.

The complete MSS of Dr. Zundel's life-work on the smuts has finally been published by the Department of Botany at Pennsylvania State College, in lithoprint.

CHAPTERS FOUNDED

- ALPHA**—Ohio State University, Columbus, Ohio, 17 March 1915.
- BETA**—University of Michigan, Ann Arbor, Michigan, 3 June 1916.
- GAMMA**—North Dakota Agricultural College, Fargo, North Dakota, (1916).
- DELTA**—University of Maine, Orono, Maine, 27 January 1917.
- EPSILON**—University of Denver, Denver, Colorado, 5 March 1917.
- ZETA**—University of Wisconsin, Madison, Wisconsin, 30 May 1917.
- ETA**—University of Akron, Akron, Ohio, 20 April 1921.
- THETA**—Michigan State College, Lansing, Michigan, 9 April 1921.
- IOTA**—Washington University, St. Louis, Missouri, 28 May 1921.
- KAPPA**—University of Kansas, Lawrence, Kansas, 31 May 1921.
- LAMBDA**—University of Montana, Missoula, Montana, 4 May 1921.
- MU**—University of California, Berkeley, California, 27 April 1922.
- NU**—Washington and Jefferson College, Washington, Pennsylvania, 11 May 1922.
- XI**—University of Nebraska, Lincoln, Nebraska, 3 May 1924.
- OMICRON**—University of North Dakota, Grand Forks, North Dakota, 26 May 1924.
- PI**—Emory University, Georgia, 3 January 1925.
- RHO**—University of Illinois, Urbana, Illinois, 28 March 1925.
- SIGMA**—University of Florida, Gainesville, Florida, 4 December 1925.
- TAU**—Duke University, Durham, North Carolina, 4 March 1926.
- UPSILON**—Miami University, Oxford, Ohio, 7 May 1926.
- PHI**—University of New Hampshire, Durham, New Hampshire, 21 May 1926.
- CHI**—Montana State College, Bozeman, Montana, 11 February 1927.
- PSI**—University of Washington, Seattle, Washington, 7 April 1928.
- OMEGA**—University of Oklahoma, Norman, Oklahoma, 24 March 1928.
- ALPHA ALPHA**—University of Southern California, Los Angeles, California, 17 May 1928.
- ALPHA BETA**—Mount Union College, Alliance, Ohio, 17 May 1928.
- ALPHA GAMMA**—University of South Dakota, Vermillion, South Dakota, 15 May 1928.
- ALPHA DELTA**—Lawrence College, Appleton, Wisconsin, 17 March 1929.
- ALPHA EPSILON**—University of Pittsburgh, Pittsburgh, Pennsylvania, 23 March 1929.
- ALPHA ZETA**—College of William and Mary, Williamsburg, Virginia, 19 April 1930.
- ALPHA ETA**—Oklahoma Agricultural and Mining College, Stillwater, Oklahoma, 13 March 1930.
- ALPHA THETA**—State College of Washington, Pullman, Washington, May 1930.
- ALPHA IOTA**—Bucknell University, Lewisburg, Pennsylvania, 9 January 1932.
- ALPHA KAPPA**—Hunter College, New York City, 8 January 1932.
- ALPHA LAMBDA**—University of Utah, Salt Lake City, Utah, 13 February 1932.
- ALPHA MU**—University and State College of Oregon, Eugene-Portland-Corvallis, Oregon, 18 November 1933.
- ALPHA NU**—University of New Mexico, Albuquerque, New Mexico, 21 April 1935.
- ALPHA XI**—University of Rhode Island, Kingston, Rhode Island, 17 May 1935.
- ALPHA OMICRON**—Marquette University, Milwaukee, Wisconsin, 18 June 1938.
- ALPHA PI**—University of Colorado, Boulder, Colorado, 24 May 1941.
- ALPHA RHO**—University of Arkansas, Fayetteville, Arkansas, 23 May 1945.
- ALPHA SIGMA**—University of Texas, Austin, Texas, 2 February 1946.
- ALPHA TAU**—National University of Mexico, Mexico, D.F., 7 April 1947.
- ALPHA UPSILON**—University of California at Los Angeles, California, 17 May 1947.
- ALPHA PHI**—College of Puget Sound, Tacoma, Washington, 28 February 1948.
- ALPHA CHI**—University of the Philippines, Manila, Luzon, P.I., 12 March 1949.
- ALPHA PSI**—Virginia Polytechnic Institute, Blacksburg, Virginia, 24 May 1949.
- ALPHA OMEGA**—University of Georgia, Athens, Georgia, 17 May 1951.
- BETA ALPHA**—Pennsylvania State Univ., State College, Pennsylvania, 26 May 1955.
- BETA BETA**—Florida State University, Tallahassee, Florida, 18 February 1956.
- BETA GAMMA**—Long Island University, Brooklyn, N. Y., 27 April 1957.

THE BIOLOGIST

THE COUNCIL

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MILE POSTS

- 1915 March 17, Alpha Chapter organized, Ohio State University, Columbus.
- 1916 May, Central Governing Body organized, "Biologist" first issued.
- 1924 December, First National Meeting, Constitution revised, Washington, D. C.
- 1925 December, Second National Meeting, Kansas City.
- 1926 December, Third National Meeting, Philadelphia.
- 1928 December, Fourth National Meeting, New York, Coat-of-arms adopted.
- 1930 January, Council Meeting, Ritual revised, Norman, Okla.
December, Fifth National Meeting, Cleveland.
- 1931 Phi Sigma Letters Registered, U. S. Patent Office.
- 1933 June, Sixth National Meeting, Chicago
- 1935 December, Seventh National Meeting, St. Louis.
- 1937 December, Eighth National Meeting, Indianapolis.
- 1939 December, Ninth National Meeting, Silver Anniversary, Ohio State University, Columbus.
- 1941 December, Tenth National Meeting, Dallas, Texas.
- 1946 December, Eleventh National Meeting, Boston, Mass.
- 1948 December, Twelfth Meeting, Albuquerque, N. Mex.
- 1950 December, Thirteenth Meeting, Denver and Boulder, Colo.
- 1952 December, Fourteenth Meeting, St. Louis, Mo.
- 1954 September, Fifteenth Meeting, Gainesville, Fla.
- 1956 September, Sixteenth Meeting, Ann Arbor, Mich.

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